Supporting Information

Inherently chiral phosphonatocavitands as artificial chemo and enantioselective receptors of natural ammoniums

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CONTENT OF THE SUPPORTING INFORMATION :

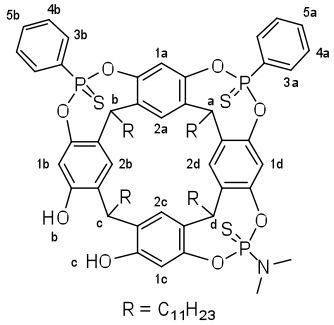
GENERAL REMARKS

Reactions were carried out using commercial available reagents in oven-dried apparatus. Toluene, Et_2O and THF were dried and distilled from sodium benzophenone under nitrogen just before use. CH_2Cl_2 was dried over powdered CaH_2 and distilled under nitrogen just before use. Resolution of enantiomers was performed using a Lachrom Elite HPLC using commercial semi-preparative chiral column Chiralpak IC (250 x 10 mm, 5 μm) or Chiralpak IA (250 x 10 mm, 5 μm) thermostated at 30 °C with UV detector at 254 nm and CD detector at 277 nm. Enantiomeric excesses (ee) were determined by HPLC using commercial analytical chiral column Chiralpak IC (250 x4.6 mm, 5 μm) or Chiralpak IA (250 x 4,6 mm, 5 μm) using same conditions. Optical rotations were measured on a Perkin-Elmer 241 MC polarimeter, equipped with a sodium lamp (589 nm), a mercury lamp (578, 546, 436 and 365 nm), a 10 cm double envelop cell thermostated at 25°C and were reported as follows: $[\alpha]^{25}_{D}$ (c g/100 mL, in solvent). NMR experiments were recorded on 200 MHz (4.7 T) or 500 MHz (11.7 T) NMR spectrometers. *J* Coupling constants are in Hz; chemical shifts are in δ values relative to Me_4Si (^1H and ^{13}C) or H_3PO_4 85% (^{31}P). ^{13}C and ^{31}P NMR spectra are proton decoupled. Spectra are reported as follows: chemical shift (δ ppm), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants (Hz), integration and assignment. HRMS was recorded on a commercial apparatus (ESI Source, TOF). Mass spectra were acquired on an ion trap instrument, detecting positive (+) ions in the ESI mode. Electronic Circular Dichroism (ECD) spectra were recorded on a JASCO J-815 CD spectrometer in a 1.0 cm quartz cell; λ are given in nm and molar circular dichroic absorptions $\Delta\varepsilon$ in $cm^2.mmol^{-1}$.

Synthesis of cavitands (±)-3 *"ABii*(PS,PN,C_{11})" and 4 *"ABii*(PS,bisPN,C_{11})"

Triethylamine (120 µL, 0,87 mmol) was added to a solution of compound **2** (300 mg, 0.22 mmol) in toluene (30 mL). Hexamethylphosphorous triamide (40 µL, 0,22 mmol) was added at 75°C. The resultant mixture was stirred at 75°C for 90 min, sulfur (30 mg, 0.93 mmol) was then added and the solution was stirred at 75°C for one more hour. After evaporation of the solvent, the crude compound was purified by silica gel column chromatography (eluent CH_2Cl_2/pentane: from 1:1 to 3:1 then CH_2Cl_2/ethyl acetate: from 1:0 to 7:3) to give the di-bridged compound **4** (47 mg, 13%), the mono-bridged compound **3** (140 mg, 43%) and the starting compound **2** (60 mg, 20%).

(±)-3 *"ABii*(PS,PN,C_{11})"



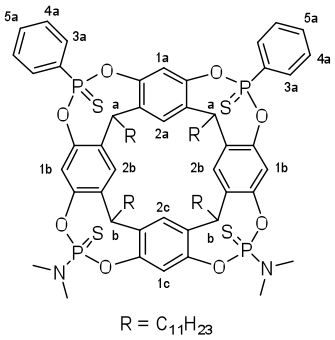
LSIMS *m/z* 1486.7618 [M + H]+ (calc. 1486.7545)

^{31}P NMR ($CDCl_3$, 300 K, 81.01 MHz): δ 66.67 (1P, S*P*N), 77.88 (1P, S*P*Ph), 78.70 (1P, S*P*Ph)

^{1}H NMR ($CDCl_3$, 300 K, 200.13 MHz): δ 0.87 (m, 12H, CH_3), 1.26 (m, 72H, -CH_2-(CH_2)$_9$-CH_3), 2.27 (m, 8H, -CH_2- (CH_2)$_9$-CH_3), 2.98 (d, 6H, PN-CH_3, $^3J_{P-H}$ = 12.3 Hz), 4.35 (t, 1 H, CH_c, ^3J = 7.4 Hz), 4.56 (t, 1 H, CH_d, ^3J = 7.4 Hz), 4.68 (m, 2 H, CH_a + CH_b), 6.50 (m, 2H, H_{1b} + H_{1c}), 6.63 (m, 2H, H_{1a} + H_{1d}), 7.11 (m, 2H, H_{2b} + H_{2c}), 6.63 (m, 2H, H_{2a} + H_{2d}), 7.53 (m, 4H, H_4 + H_5), 8.14 (m, 4H, H_3)

^{13}C NMR ($CDCl_3$, 300 K, 125.75 MHz): δ 14.14 (-CH_2-(CH_2)$_9$-CH_3), 22.72 (-CH_2-(CH_2)$_7$-CH_2-CH_3), 28.02 (-CH_2-(CH_2)$_9$-CH_3), 29.43 (-CH_2-(CH_2)$_9$-CH_3), 29.75 (-CH_2-(CH_2)$_9$-CH_3), 30.58 (-CH_2-CH_2-(CH_2)$_8$-CH_3), 30.94 (-CH_2-CH_2-(CH_2)$_8$-CH_3), 31.69 (-CH_2-CH_2-(CH_2)$_8$-CH_3), 31.96 (-CH_2-CH_2-(CH_2)$_8$-CH_3), 33.66 (-CH_2-CH_2-(CH_2)$_8$-CH_3), 33.84 (CH_c), 35.46 (C$H_{a/b/d}$), 35.76 (C$H_{a/b/d}$) 35.98 (C$H_{a/b/d}$), 37.55 (CH_3-N-P), 111.47 (CH_{1b}/c), 111.98 (CH_{1b}/c), 119.16 (C$H_{1a/d}$), 119.41 (C$H_{1a/d}$), 121.30 (CH_2), 121.73 (CH_2), 122.60 (CH_2), 122.92 (CH_2), 128.31 (d, C$_{4a/b}$, ^3J = 15.5 Hz), 128.35 (d, C$_{4a/b}$, ^3J = 15.5 Hz), 129.37 (C$_{Ar}$), 129.83 (C$_{Ar}$), 130.42 (C$_{Ar}$), 131.10 (d, C$_3$, ^2J = 11.5 Hz), 132.67 (C$_5$), 133.63 (C$_{Ar}$), 134.70 (C$_{Ar}$), 135.14 (C$_{Ar}$), 135.79 (C$_{Ar}$), 136.03 (C$_{Ar}$), 146.38 (m, C$_{Ar}$-OP), 151.51 (C$_{Ar}$-OH), 151.76 (C$_{Ar}$-OH)

4 "*ABii*(PS,bisPN,C_{11})"



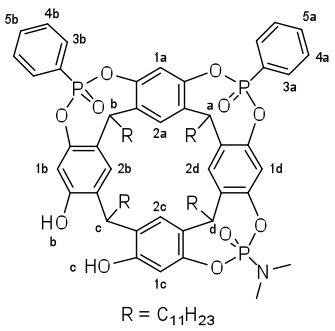
LSIMS *m/z* 1613.7224 [M + Na]+ (calc. 1613.7240)

^{31}P NMR ($CDCl_3$, 300 K, 81.01 MHz): δ 68.64 (2P, S*P*N), 79.31 (2P, S*P*Ph)

^{1}H NMR ($CDCl_3$, 300 K, 200.13 MHz): δ 0.87 (m, 12H, C*H*$_3$), 1.27 (m, 72H, -CH_2-(C*H*$_2$)$_9$-CH_3), 2.27 (m, 8H, -C*H*$_2$- (CH_2)$_9$-CH_3), 2.94 (d, 12H, PN-C*H*$_3$, $^{3}J_{P\text{-}H}$ = 11.9 Hz), 4.56 (t, 2 H, C*H*$_b$, ^{3}J = 7.1 Hz), 4.69 (t, 2 H, C*H*$_a$, ^{3}J = 7.1 Hz), 6.61 (m, 4H, *H*$_1$), 7.14 (s, 1H, *H*$_{2a/c}$), 7.17 (s, 2H, *H*$_{2b}$), 7.21 (s, 1H, *H*$_{2a/c}$), 7.52 (m, 4H, H_4 + *H*$_5$), 8.14 (dd, 4H, $^{3}J_{H\text{-}H}$ = 7.2 Hz, $^{3}J_{P\text{-}H}$ = 14.6 Hz, *H*$_3$)

^{13}C NMR ($CDCl_3$, 300 K, 50.33 MHz): δ 14.13 (-CH_2-(CH_2)$_9$-CH_3), 22.71 (-CH_2-(CH_2)$_7$-CH_2-CH3), 27.97 (-CH_2-(CH_2)$_9$-CH_3), 29.42 (-CH_2-(CH_2)$_9$-CH_3), 29.74 (-CH_2-(CH_2)$_9$-CH_3), 30.92 (-CH_2-CH_2-(CH_2)$_8$-CH_3), 31.22 (-CH_2-CH_2-(CH_2)$_8$-CH_3), 31.96 (-CH_2-CH_2-(CH_2)$_8$-CH_3), 35.74 (*C*H$_{a/b}$), 36.02 (*C*H$_{a/b}$), 37.53 (d, CH_3-N-P, ^{2}J = 3.8 Hz), 119.87 (m, *C*H$_1$), 121.39 (*C*H$_{2a/c}$), 121.80 (*C*H$_{2b}$), 122.16 (*C*H$_{2a/c}$), 128.23 (d, C$_4$, ^{3}J = 15.8 Hz), 131.13 (d, C$_3$, ^{2}J = 12.0 Hz), 132.05 (d, C*P*, ^{1}J = 162.3 Hz) 132.05 (C$_5$), 134.39 (C$_{Ar}$), 134.60 (C$_{Ar}$), 134.82 (C$_{Ar}$), 135.07 (C$_{Ar}$), 146.32 (C$_{Ar}$-OP), 146.54 (C$_{Ar}$-OP), 146.88 (C$_{Ar}$-OP), 147.06 (C$_{Ar}$-OP).

Synthesis of cavitand (±)-5 "ABii(PO,PN,C_{11})"



m-Chloroperoxybenzoic acid (66.5 mg, 0,38 mmol) was added to a solution of cavitand (±)-**3** (100 mg, 0.07 mmol) in $CHCl_3$ (10 mL). The mixture was stirred at room temperature for 1 h. After evaporation of the solvent, the crude compound was purified by silica gel column chromatography (eluent CH_2Cl_2/THF from 9:1 to 1:1) to give (±)-**5** as a white solid (35 mg, 35%).

LSIMS *m/z* 1438.8303 [M + H]+ (calc. 1438.8231)

^{31}P NMR ($CDCl_3$, 300 K, 81.01 MHz): δ -1.67 (1P, S*P*N), 8.13 (1P, S*P*Ph), 8.73 (1P, S*P*Ph)

^{1}H NMR ($CDCl_3$, 300 K, 500.10 MHz): δ 0.86 (m, 12H, C*H*$_3$), 1.24 (m, 72H, -CH_2-(CH_2)$_9$-CH_3), 2.10 (m, 2H, (-CH_2- (CH_2)$_9$-CH_3)$_c$), 2.26 (m, 6H, -CH_2- (CH_2)$_9$-CH_3), 2.85 (d, 6H, PN-CH_3, $^{3}J_{P\text{-}H}$ = 10.7 Hz), 4.31 (t, 1 H, C*H*$_c$, ^{3}J = 7.7 Hz), 4.53 (t, 1 H, C*H*$_d$, ^{3}J = 7.5 Hz), 4.69 (m,

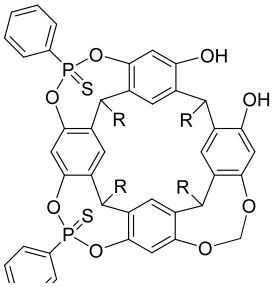
2 H, CH_b+ CH_a), 6.62 (s, 1H, H_{1b}), 6.65 (s, 1H, H_{1c}), 6.89 (s, 1H, H_{1d}), 6.94 (s, 1H, H_{1a}), 7.05 (s, 1H, H_{2c}), 7.07 (s, 1H, H_{2b}), 7.19 (s, 1H, H_{2d}), 7.23 (s, 1H, H_{2a}), 7.50 (m, 4H, H_4), 7.59 (m, 2H, H_5), 8.02 (m, 4H, H_3)

^{13}C NMR ($CDCl_3$, 300 K, 50.32 MHz): δ 14.13 (-CH_2-$(CH_2)_9$-$\underline{C}H_3$), 22.71 (-CH_2-($\underline{C}H_2)_9$-CH_3), 27.93 (m, -CH_2-($\underline{C}H_2)_9$-CH_3), 29.42 (m, -CH_2-($\underline{C}H_2)_9$-CH_3), 29.74 (m, -CH_2-($\underline{C}H_2)_9$-CH_3), 30.38 ((-$\underline{C}H_2$-$(CH_2)_9$-$CH_3)_{b/a/d}$), 30.76 ((-$\underline{C}H_2$-$(CH_2)_9$-$CH_3)_{a/b/d}$), 30.99 ((-$\underline{C}H_2$-$(CH_2)_9$-$CH_3)_{a/b/d}$), 31.96 (m, -CH_2-($\underline{C}H_2)_9$-CH_3), 33.61 ((-$\underline{C}H_2$-$(CH_2)_9$-$CH_3)_c$), 33.80 (CH_c), 35.43 (CH_d), 35.86 (CH_b), 36.96 (CH_a), 36.91 ($\underline{C}H_3$-N-P), 110.67 (CH_{1c}), 111.54 (CH_{1b}), 116.86 (CH_{1d}), 117.21 (CH_{1a}), 121.30 (CH_{2d}), 121.82 (CH_{2a}), 122.53 (CH_{2c}), 122.82 (CH_{2b}), 126.51 (d, $\underline{C}$P, ^{1}J = 202.0 Hz), 126.75 (d, $\underline{C}$P, ^{1}J = 202.0 Hz), 128.32 ($\underline{C}_{Ar}$ entre H_b et H_{2b}), 128.39 ($\underline{C}_{Ar}$ entre H_d et H_{2c}), 128.43 (d, $\underline{C}_4$, ^{3}J = 15.9 Hz), 128.59 (d, $\underline{C}_4$, ^{3}J = 15.9 Hz), 129.26 ($\underline{C}_{Ar}$ between H_c et H_{2c}), 129.96 ($\underline{C}_{Ar}$ between H_c et H_{2b}), 131.70 (m, $\underline{C}_3$), 131.44, 133.10 (m, $\underline{C}_5$), 134.08 ($\underline{C}_{Ar}$ entre H_a et H_{2d}), 134.59 ($\underline{C}_{Ar}$ entre H_a et H_{2a}), 135.76 ($\underline{C}_{Ar}$ entre H_d et H_{2d}), 135.86 ($\underline{C}_{Ar}$ entre H_a et H_{2b}), 145.40 ($\underline{C}_{Ar}$-OP near H_{1b}), 145.63 ($\underline{C}_{Ar}$-OPN near H_{1c}), 146.04 ($\underline{C}_{Ar}$-OP near H_{1a} + $\underline{C}_{Ar}$-OP near H_{1d}), 146.43 ($\underline{C}_{Ar}$-OP near H_{1a}), 146.89 ($\underline{C}_{Ar}$-OPN near H_{1d}), 152.37 ($\underline{C}_{Ar}$-OH_c), 152.99 ($\underline{C}_{Ar}$-OH_b)

Synthesis of cavitands (±)-6 "*ABii*(PS,CH_2,C_{11})" and 7 "*ABii*(PS,bisCH_2,C_{11})"

To a solution of compound **2** (160 mg, 0,116 mmol) in dry DMF (15 mL) was added, under N_2 atmosphere, potassium carbonate (40 mg, 0,289 mmol) and iodochloromethane (20,5 mg, 0,116 mmol) in DMF (5 mL). The mixture was stirred at 90 °C for 15 h and then poured into water (100mL). The solution was extracted with ethyl acetate (4 x 50 mL), and the combined organic phases were washed with brine, dried over Na_2SO_4 and evaporated to dryness under vacuum to give a brown residue. The crude compound was purified by silica gel column chromatography (eluent CH_2Cl_2/EtOAc from 99:1 to 95:5) to give compound **7** as a white solid (40 mg, 21%). Further elution with CH_2Cl_2/EtOAc from 95:5 to 9:1 gave compound (±)-**6** as a white solid (85 mg, 53%).

(±)-6 "*ABii*PSCH2C$_{11}$"



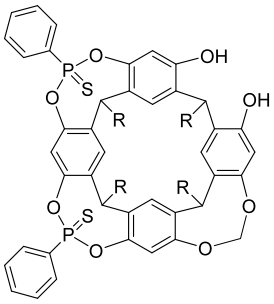
LSIMS *m/z* 1393.7827 [M + H]+ (calc. 1393.7743)

^{31}P NMR ($CDCl_3$, 300 K, 81.01 MHz) : δ 77.69 (1P), 77.67 (1P).

^{1}H NMR ($CDCl_3$, 300 K, 500.10 MHz) δ 0.87 (m, 12H, C$\underline{H}_3$), 1.25-1.44 (m, 72H, -CH_2-(C$\underline{H}_2$)$_9$-CH_3), 2.27 (m, 8H, (-C$\underline{H}_2$- (CH_2)$_9$-CH_3)), 4.33 (t, J = 7.5 Hz, 1 H), 4.60-4.73 (m, 3 H), 4.78 (d, J = 7.2 Hz, 1 H), 5.66 (d, J = 7.2 Hz, 1 H), 6.42 (s, 1H), 6.43 (s, 1H), 6.56 (s, 1H), 6.68 (s, 1H), 7.10 (s, 1H), 7.11 (s, 1H), 7.24 (m, 4H), 7.25 (s, 1H), 7.52 (b, 4H), 7.59 (m, 2H), 8.15 (m, 4H).

^{13}C NMR ($CDCl_3$, 300 K , 125.75 MHz) δ 15.54, 24.11, 29.40 (d), 30.83 (b), 31.18 (b), 31.32, 31.69, 32.33, 32.54, 33.36 (b), 34.62, 34.62, 35.30, 37.15, 37.32, 37.48, 100.74, 112.22, 113.25, 119.30, 120.70, 122.16, 123.27, 123.34, 124.36, 129.75 (d, ^{3}J = 15.7 Hz), 129.85 (d, ^{3}J = 15.2 Hz), 131.15, 131.41, 132.23, 132.40 (d, ^{2}J = 11.1 Hz), 133.54, 133.74, 133.32 (d, ^{2}J = 10.3 Hz), 134.64, 135.62, 137.09, 137.42, 140.79, 147.20, 147.28, 147.36, 152.71, 152.97, 156.42, 156.81.

7 "*ABii*PSbisCH2C$_{11}$"



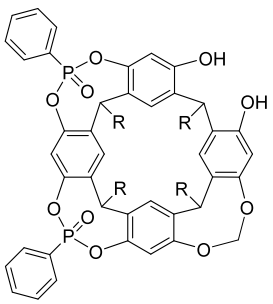
LSIMS *m/z* 1427.7619 [M + Na]+ (calc. 1427.7636)

^{31}P NMR ($CDCl_3$, 300 K, 81.01 MHz) : δ 78.29 (2P).

^{1}H NMR ($CDCl_3$, 300 K, 500.10 MHz) δ 0.86 (m, 12H, C$\underline{H}_3$), 1.24-1.43 (m, 72H, -CH_2-(C$\underline{H}_2$)$_9$-CH_3), 2.22-2.28 (m, 8H, (-C$\underline{H}_2$- (CH_2)$_9$-CH_3)), 4.64 (d, J = 7.3 Hz, 2H), 4.69 (t, J = 8.1 Hz, 2H), 4.74 (t, J = 8.1 Hz, 2H), 5.70 (d, J = 7.2 Hz, 2 H), 6.55 (s, 1H), 6.56 (s, 1H), 6.57 (s, 1H), 6.66 (s, 1H), 7.17 (s, 1H), 7.18 (s, 1H), 7.19 (s, 2H), 7.52 (m, 4H), 7.61 (t, J = 7.1 Hz, 2H), 8.11 (d, J = 7.3 Hz, 2H), 8.14 (d, J = 7.2 Hz, 2H).

^{13}C NMR ($CDCl_3$, 300 K , 125.75 MHz) δ 14.14, 22.71, 27.94, 28.00, 29.38, 29.42, 29.80, 29.89, 30.23, 30.88, 31.96, 36.02, 36.34, 99.76, 117.09, 118.11, 119.84, 120.34, 121.25, 122.25, 128.44 (d, ^{3}J = 15.8 Hz), 128.37, 128.50, 131.04 (d, ^{2}J = 11.8 Hz), 132.16, 132.98, 134.30, 135.67, 137.75, 138.99, 145.95 (d, ^{2}J = 11.8 Hz), 145.97, 155.06, 155.16.

Synthesis of cavitand (±)-8 "*ABii*(PO,CH_2,C$_{11}$)"



m-Chloroperoxybenzoic acid (32.9 mg, 0,133 mmol) was added to a solution of cavitand (±)-**6** (62 mg, 0,044 mmol) in $CHCl_3$ (5 mL). The mixture was stirred at room temperature for 2 h. After evaporation of the solvent, the crude compound was purified by silica gel column chromatography (eluent CH_2Cl_2 to CH_2Cl_2/THF 9:1 to CH_2Cl_2/THF/Acetone 7:1:2) to give compound (±)-**8** as a white solid

(57 mg, 95%).

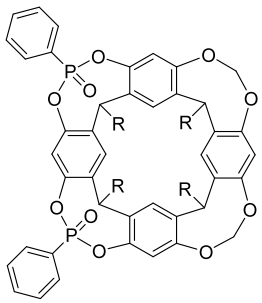
LSIMS *m/z* 1361.8268 [M + H]+ (calc. 1361.8200)

^{31}P NMR ($CDCl_3$, 300 K, 202.45 MHz) : δ 10.57 (1P), 9.63 (1P).

^{1}H NMR ($CDCl_3$, 300 K, 500.10 MHz) δ 0.86 (m, 12H, CH_3), 1.25 (m, 72H, -CH_2-(C$\underline{H}_2$)$_9$-CH_3), 2.20 (m, 8H, (-C$\underline{H}_2$- (CH_2)$_9$-CH_3)), 4.31 (t, J = 7.4 Hz, 1 H), 4.60 (m, 2 H), 4.69 (m, 2 H), 5.61 (d, J = 6.9 Hz, 1 H), 6.34 (s, 1H), 6.53 (s, 1H), 7.04 (s, 1H), 7.09 (s, 1H), 7.19 (s, 1H), 7.23 (s, 1H), 7.48 (m, 4H), 7.54 (q, J = 7.0 Hz, 1H), 7.58 (q, J = 7.2 Hz, 1H), 8.00 (m, 4H).

^{13}C NMR ($CDCl_3$, 300 K , 125.75 MHz) δ 14.13 (d), 22.71 (d), 28.00 (m), 29.43 (m), 29.75 (m), 29.87, 29.92, 30.33, 30.36, 30.73, 30.90, 31.96 (m), 33.15, 33.85, 35.95, 36.07, 99.48, 110.65, 110.99, 116.98, 117.14, 120.88, 122.15, 123.36, 124.85, 125.54, 125.66 (d, $\underline{C}$P, ^{1}J = 204.3 Hz), 126.21 (d, $\underline{C}$P, ^{1}J = 203.9 Hz), 128.19, 128.26, 128.49, 128.54, 128.55 (d, ^{3}J = 16.4 Hz), 128.76 (d, ^{3}J = 16.3 Hz), 129.67, 130.13, 130.39, 131.55 (d, ^{2}J = 10.2 Hz), 131.67 (d, ^{2}J = 10.2 Hz), 132.35, 133.18, 133.31, 133.43, 134.47, 135.34, 139.78, 145.00, 145.08, 145.39, 145.48, 145.90, 145.99, 146.08, 152.08, 152.13, 155.46.

9 "*ABii*POBisCH2C$_{11}$"



Already described in: M. Suman, M. Freddi, C. Massera, F. Ugozzoli, and E. Dalcanale, *J. Am. Chem. Soc.*, 2003, **125**, 12068.

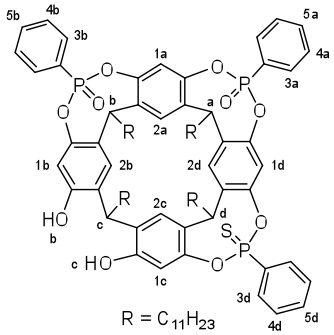
Synthesis of cavitands (±)-11 "*ABii*(PO)Ci(PS)", (±)-12 "*ABii*(PO)CDio(PS)" and 13 "*ABii*(PO)CDii(PS)".

a) The azeotropic distillation, by means of a Dean and Stark apparatus, of a suspension of compound **10** (135 mg, 0,1 mmol) in toluene (12 mL) was performed overnight under dry argon to remove traces of water from the starting material. Afterwards, pyridine (0,5 mL, 6,2 mmol), and dichlorophenylphosphine (30 µL, 0,22 mmol) were added dropwise at 0°C. The resultant mixture was stirred at 0°C for 45 min and then allowed to reach room temperature. Sulfur (10 mg, 0,31 mmol) was then added and the solution was heated at reflux temperature for 6 h. The resulting mixture was concentrated under vacuum to give a beige

residue (250 mg). Silica gel column chromatography (eluent CH_2Cl_2/THF: from 1:0 to 9:1) of the residue afforded compounds (±)-**12** (40 mg, 25%) and **13** (40 mg, 25%).

b) The azeotropic distillation, by means of a Dean and Stark apparatus, of a suspension of compound **10** (135 mg, 0,1 mmol) in toluene (12 mL) was performed overnight under dry argon to remove traces of water from the starting material. Afterwards, pyridine (0,5 mL, 6,2 mmol), and dichlorophenylphosphine (15 µL, 0,11 mmol) were added dropwise at 0°C. The resultant mixture was stirred at 0°C for 45 min and then allowed to reach room temperature. Sulfur (10 mg, 0,31 mmol) was then added and the solution was heated at reflux temperature for 6 h. The resulting mixture was concentrated under vacuum to give a beige residue (250 mg). Silica gel column chromatography (eluent: CH_2Cl_2/THF: from 1:0 to 2:1 and next CH_2Cl_2/CH_3OH 9:1) of the residue afforded the **11** compound (43 mg, 29%).

(±)-11 *"ABii*(PO)Ci(PS)"



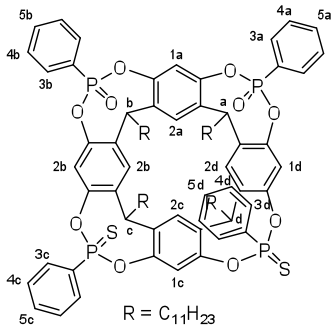
LSIMS *m/z* 1509.7786 [M + Na]+ (calc. 1509.7791)

^{31}P NMR ($CDCl_3$, 300 K, 202.45 MHz): 8.56 (1P), 9.42 (1P), 76.89 (1P)

^{1}H NMR ($CDCl_3$, 300 K, 200.13 MHz): 0.85 (m, 12H, CH_3), 1.26 (m, 72H, -CH_2-(C$\underline{H}_2$)$_9$-CH_3), 2.12 (m, 4H, -C$\underline{H}_2$- (CH_2)$_9$-CH_3), 2.26 (m, 4H, -C$\underline{H}_2$- (CH_2)$_9$-CH_3), 4.33 (m, 1H, CH_c), 4.33 (m, 3H, C$H_{a,b,d}$), 6.48 (s, 1H, H_1), 6.63 (s, 1H, H_1), 6.81 (s, 1H, H_1), 6.96 (s, 1H, H_1), 7.01 (s, 1H, H_2), 7.14 (s, 1H, H_2), 4.24 (s, 1H, H_2), 7.27 (s, 1H, H_2), 7.49 (m, 7H, $H_{4a,b,d}$ + H_{5d}), 7.57 (m, 2H, $H_{5a,b}$), 8.00 (m, 4H, $H_{3a,b}$), 8.15 (m, 2H, H_{3d})

^{13}C NMR ($CDCl_3$, 298 K, 125.76 MHz): δ 14.04 (-CH_2-(CH_2)$_9$-$\underline{C}H_3$), 22.61 (-CH_2-(CH_2)$_7$-$\underline{C}H_2$-CH3), 28.02 (-CH_2-(CH_2)$_7$-$\underline{C}H_2$-CH_2-CH_3), 29.63 (-CH_2-($\underline{C}H_2$)$_9$-CH_3), 30.15 (-CH_2-($\underline{C}H_2$)$_9$-CH_3), 30.73 (-$\underline{C}H_2$-CH_2-(CH_2)$_8$-CH_3), 31.44 (-CH_2-$\underline{C}H_2$-(CH_2)$_8$-CH_3), 31.89 (-CH_2-$\underline{C}H_2$-(CH_2)$_8$-CH_3), 33.50 (-$\underline{C}H_2$-CH_2-(CH_2)$_8$-CH_3), 33.75 (*C*H_c), 35.82 (*C*$H_{a,b,d}$), 110.13 (*C*H_1), 112.69 (*C*H_1), 117.13 (*C*H_1), 118.15 (*C*H_1), 121.65 (*C*H_2), 121.93 (*C*H_2), 122.62 (*C*H_2), 123.16 (*C*H_2), 128.30 ($\underline{C}_4$), 131.07 ($\underline{C}_{3\text{-PS}}$), 131.57 ($\underline{C}_{3\text{-PO}}$), 132.61 ($\underline{C}_{5\text{-PO}}$), 133.23 ($\underline{C}_{5\text{-PS}}$), 134.39 ($\underline{C}_{Ar}$), 136.60 ($\underline{C}_{Ar}$), 146.28 (d, $\underline{C}_{Ar}$-OP), 152.47 ($\underline{C}_{Ar}$-OH)

(±)-12 *"ABii*(PO)CDio(PS)"



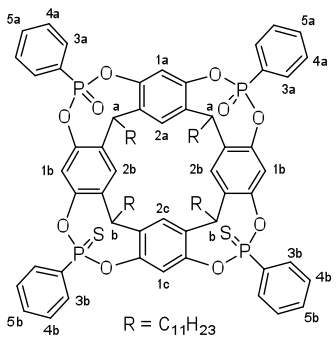
LSIMS *m/z* 1625.7659 [M + H]+ (calc. 1625.7620)

^{31}P NMR ($CDCl_3$, 298 K, 202.45 MHz): δ 8.96 (1P, *P*O), 10.51 (1P, *P*O), 77.70 (1P, *P*S), 79.25 (1P, *P*S)

^{1}H NMR ($CDCl_3$, 298 K, 500.10 MHz): δ 0.86 (m, 12H, CH_3), 1.30 (m, 72H, -CH_2-(C$\underline{H}_2$)$_9$-CH_3), 2.31 (m, 4H, -C$\underline{H}_2$- $(CH_2)_9$-CH_3), 2.37 (m, 4H, -C$\underline{H}_2$- $(CH_2)_9$-CH_3), 4.73 (t, 1 H, ^{3}J = 7.55, CH_b), 4.77 (m, 2 H, CH_a + CH_c), 4.86 (t, 1 H, ^{3}J = 7.58, CH_d), 6.27 (s, 1H, H_{1d}), 6.31 (s, 1H, H_{1c}), 6.37 (dd, 2H, $^3J_{H\text{-}H}$ = 7.8 Hz, $^3J_{P\text{-}H}$ = 14.1 Hz, H_{3d}), 6.64 (m, 2H, H_{4d}), 6.74 (s, 1H, H_{1b}), 7.01 (s, 1H, H_{2a}), 7.33 (m, 3H, H_{2a} + H_{2b}), 7.35 (s, 1H, H_{2d} + H_{5d}), 7.37 (s, 1H, H_{2c}), 7.46 (m, 4H, H_{4a} + H_{4c}), 7.56 (m, 4H, H_{4b} + H_{5a}+ H_{5c}), 7.63 (t, 1 H, ^{3}J = 7.1, H_{5b}), 7.90 (dd, 2H, $^3J_{H\text{-}H}$ = 7.3 Hz, $^3J_{P\text{-}H}$ = 14.2 Hz, H_{3a}), 7.99 (dd, 2H, $^3J_{H\text{-}H}$ = 7.4 Hz, $^3J_{P\text{-}H}$ = 14.8 Hz, H_{3c}), 8.06 (dd, 2H, $^3J_{H\text{-}H}$ = 7.3 Hz, $^3J_{P\text{-}H}$ = 14.1 Hz, H_{3b})

^{13}C NMR ($CDCl_3$, 298 K, 125.76 MHz): δ 14.12 (-CH_2-$(CH_2)_9$-$\underline{C}H_3$), 22.71 (-CH_2-($\underline{C}H_2$)$_9$-CH_3), 28.01 (m, -CH_2-($\underline{C}H_2$)$_9$-CH_3), 29.42 (m, -CH_2-($\underline{C}H_2$)$_9$-CH_3), 29.73 (m, -CH_2-($\underline{C}H_2$)$_9$-CH_3), 30.49 (-$\underline{C}H_2$-$(CH_2)_9$-CH_3), 31.58 (-$\underline{C}H_2$-$(CH_2)_9$-CH_3), 31.95 (m, -CH_2-($\underline{C}H_2$)$_9$-CH_3), 36.07 (CH_d), 36.23 (CH_a + CH_b + CH_c), 118.10 (CH_1), 118.97 (CH_1), 121.85 (CH_{2b} + CH_{2b}), 121.00 (CH_{2d}), 122.22 (CH_{2c}) 123.90 (d, $\underline{C}PS_d$, ^{1}J = 126.3 Hz), 125.68 (d, $\underline{C}PO_a$, ^{1}J = 202.7 Hz), 126.06 (d, $\underline{C}PO_b$, ^{1}J = 206.0 Hz), 128.50 ($\underline{C}_{4a}$ + $\underline{C}_{4b}$ + $\underline{C}_{4c}$), 128.83 (d, $\underline{C}_{4d}$, ^{3}J = 14.2 Hz), 128.56 (d, $\underline{C}_4$, ^{3}J = 16.1 Hz), 129.27 ($\underline{C}_{7/8}$), 130.84 (d, $\underline{C}PS_d$, ^{1}J = 155.9 Hz), 130.94 (d, $\underline{C}_{3c}$, ^{2}J = 11.49 Hz), 131.63 ($\underline{C}_{3a}$ + $\underline{C}_{3b}$), 132.35 (d, $\underline{C}_{3d}$, ^{2}J = 10.81 Hz), 133.00 ($\underline{C}_{5c}$), 133.39 ($\underline{C}_{5a}$ + $\underline{C}_{5b}$), 133.39 ($\underline{C}_{Ar}$ entre H_d et H_{2d}), 133.91 ($\underline{C}_{Ar}$ entre H_d et H_{2c}), 134.35 ($\underline{C}_{5d}$), 134.70 ($\underline{C}_{Ar}$ entre H_b et H_{2b}), 134.00 ($\underline{C}_{Ar}$ entre H_b et H_{2a}), 135.24 ($\underline{C}_{Ar}$ entre H_a et H_{2a}), 135.58 ($\underline{C}_{Ar}$ entre H_c et H_{2c}), 135.73 ($\underline{C}_{Ar}$ entre H_c et H_{2b}), 136.00 ($\underline{C}_{Ar}$ entre H_a et H_{2b}), 145.94 ($\underline{C}_{Ar}$-OPS_c near H_{2c} + $\underline{C}_{Ar}$-OPS_c near H_{2b} + $\underline{C}_{Ar}$-OPO_b near H_{2b} + $\underline{C}_{Ar}$-OPO_b near H_{2a} + $\underline{C}_{Ar}$-OPO_a near H_{2a}), 146.40 (d, $\underline{C}_{Ar}$-OPO_a near H_{1d}, ^{2}J = 9.9 Hz), 148.70 ($\underline{C}_{Ar}$-OPS_d near H_{2d}), 149.16 ($\underline{C}_{Ar}$-OPS_d near H_{2c})

13 "*ABii*(PO)CDii(PS)".



LSIMS *m/z* 1647.7445 [M + Na]+ (calc. 1647.7479)

^{31}P NMR ($CDCl_3$, 300 K, 82.01 MHz): δ 8.46 (2P, $\underline{P}$O), 79.42 (2P, $\underline{P}$S)

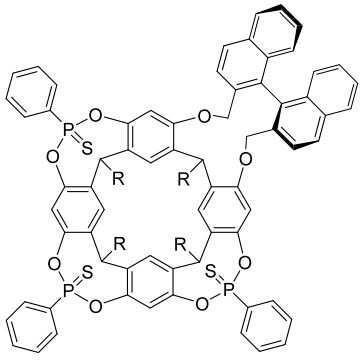
^{1}H NMR ($CDCl_3$, 298 K, 500.10 MHz): δ 0.86 (m, 12H, CH_3), 1.29 (m, 72H, -CH_2-(C$\underline{H}_2$)$_9$-CH_3), 2.32 (m, 8H, -C$\underline{H}_2$-$(CH_2)_9$-CH_3), 4.73 (t, 2 H, CH_b, ^{3}J = 7.35 Hz), 4.77 (t, 2 H, CH_a, ^{3}J = 7.25 Hz), 6.63 (s, 1H, H_{1c}), 6.77 (s, 2H, H_{1b}), 6.93 (s, 1H, H_{1a}), 7.26 (s, 1H, $H_{2a/c}$), 7.28 (s, 2H, H_{2b}), 7.30 (s, 1H, $H_{2a/c}$), 7.49 (m, 8H, H_4), 7.57 (m, 4H, H_5), 8.03 (dd, 4H, $^3J_{H\text{-}H}$ = 7.48 Hz, $^3J_{P\text{-}H}$ = 14.03 Hz, $H_{3\text{-}PO}$), 8.13 (dd, 4H, $^3J_{H\text{-}H}$ = 7.48 Hz, $^3J_{P\text{-}H}$ = 14.73 Hz, $H_{3\text{-}PS}$)

^{13}C NMR ($CDCl_3$, 298 K, 125.76 MHz): δ 14.13 (-CH_2-$(CH_2)_9$-$\underline{C}H_3$), 22.71 (-CH_2-$(CH_2)_7$-$\underline{C}H_2$-CH3), 28.02 (-CH_2-$(CH_2)_7$-$\underline{C}H_2$-CH_2-CH_3), 29.42 (-CH_2-($\underline{C}H_2$)$_9$-CH_3), 29.75 (-CH_2-($\underline{C}H_2$)$_9$-CH_3), 30.95 (-$\underline{C}H_2$-CH_2-$(CH_2)_8$-CH_3), 31.30 (-$\underline{C}H_2$-CH_2-$(CH_2)_8$-CH_3), 31.96 (-CH_2-$\underline{C}H_2$-$(CH_2)_8$-CH_3), 36.04 (C$H_{b/a}$), 36.15 (C$H_{a/b}$), 117.77 (CH_{1a}), 119.06 (CH_{1b}), 120.26 (CH_{1c}), 122.05 (m, CH_2), 126.42 (d, $\underline{C}$PO, ^{1}J = 202.8 Hz), 128.28 (d, $\underline{C}_{4\text{-}PS}$, ^{3}J = 15.6 Hz), 128.46 (d, $\underline{C}_{4\text{-}P0}$, ^{3}J = 16.1 Hz), 131.11 (d, $\underline{C}_{3\text{-}PS}$, ^{2}J = 11.6 Hz), 131.73 (d, $\underline{C}_{3\text{-}PO}$, ^{2}J = 9.9 Hz), 131.86 (d, $\underline{C}$PS, ^{1}J = 162.3 Hz), 132.70 ($\underline{C}_{5\text{-}PS}$), 133.19 ($\underline{C}_{5\text{-}PO}$), 134.51 ($\underline{C}_{Ar}$ entre H_a et H_{2b}), 134.83 ($\underline{C}_{Ar}$ between H_b et H_{2c}), 135.05 ($\underline{C}_{Ar}$ entre H_a et H_{2a}), 135.37 ($\underline{C}_{Ar}$ between H_b et H_{2b}), 145.79 (d, $\underline{C}_{Ar}$-OPO near H_{1b}, ^{2}J = 9.5), 146.27 (d, $\underline{C}_{Ar}$-OPO near H_{1a}, ^{2}J = 10.8), 146.54 (d, $\underline{C}_{Ar}$-OPS near H_{1c}, ^{2}J = 10.2), 146.80 (d, $\underline{C}_{Ar}$-OPS near H_{1b}, ^{2}J = 10.0)

Synthesis of cavitand (±)-15 ($C_{11}H_{23}$) and (*Ra*)-15 ($C_{11}H_{23}$)

In a dry Schlenk containing compounds **14** (0.083 mmol, 1 eq.), 2,2'-bis(bromomethyl)-1,1'-binaphthyl (44 mg, 0.1000 mmol) and cesium carbonate (81 mg, 0.2487 mmol), was added dry acetonitrile (5 mL). The mixture was heated at 80 °C for 150 min. The solvent was concentred, the residue dissolved in CH_2Cl_2 (20 mL), washed with water (20 mL) and brine (20 mL). The organic phase was dried over Na2SO4 and the solvent removed *in vacuo*. Silica gel column chromatography (eluent: CH_2Cl_2/cyclohexane: 1:1 (100 mL) then CH_2Cl_2 (100 mL) then CH_2Cl_2/EtOAc: 1:1 (100 mL)) of the residue afforded compound **15** (97% yield) as a white solid.

Compound 15



LSIMS *m/z* 1819.8398 [M + Na]+ (calc. 1819.8424)

^{31}P NMR ($CDCl_3$, 300 K, 202.45 MHz): 79.26, 78.45, 77.71.

^{1}H NMR ($CDCl_3$, 300 K, 200.13 MHz): 0.87 (m, 12H), 1.06-1.63 (m, 72H), 1.87 (m, 1H), 1.96 (m, 1H), 2.25-2.33 (m, 6H), 4.29 (d, 1H, J = 9.3 Hz), 4.49 (d, 1H, J = 12.6 Hz), 4.61 (d, 2H,

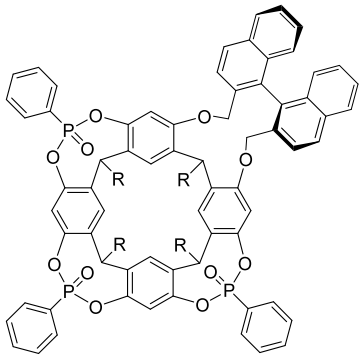
J = 9.3 Hz), 4.68 (t, 1H, J = 7.5 Hz), 4.75 (t, 1H, J = 7.5 Hz), 4.88 (t, 1H, J = 8.3 Hz), 5.11 (d, 1H, J = 12.4 Hz), 6.10 (s, 1H), 6.60 (s, 1H), 6.71 (s, 1H), 6.94 (s, 1H), 6.98 (d, 1H, J = 8.5 Hz), 7.12 (m, 3H), 7.25 (m, 1H), 7.34 (d, 2H, J = 5.6 Hz), 7.37 (d, 1H, J = 7.6 Hz), 7.45-7.63 (m, 11H), 7.70 (d, 1H, J = 8.5 Hz), 7.76 (s, 2H), 7.84 (d, 1H, J = 8.2 Hz), 7.94 (d, 1H, J = 8.2 Hz), 8.00 (d, 1H, J = 8.5 Hz), 8.06 (d, 1H, J = 8.5 Hz), 8.08 (d, 1H, J = 7.4 Hz), 8.15 (d, 1H, J = 7.4 Hz) 8.18 (d, 1H, J = 7.4 Hz), 8.24 (d, 1H, J = 7.3 Hz), 8.27 (d, 1H, J = 7.3 Hz).

^{13}C NMR ($CDCl_3$, 298 K, 125.75 MHz): δ 14.13, 22.71, 23.31, 25.23, 27.90, 27.97, 28.07, 28.11, 29.43, 29.71, 29.75, 29.79, 29.82, 30.84, 31.31, 31.62, 31.71, 31.96, 32.00, 25.56, 35.72, 35.84, 35.92, 66.62, 68.81, 107.21, 107.90, 119.03, 119.37, 121.54, 121.69, 123.52, 123.75, 125.70, 125.79, 126.24, 126.41, 126.59, 128.00, 128.17, 128.19, 128.23, 128.29, 128.35, 128.42, 128.46, 128.91, 130.96, 131.03, 131.05, 131.10, 131.12, 131.19, 131.51, 131.70, 131.74, 131.89, 132.52, 132.64, 132.72, 132.81, 133.00, 133.04, 133.13, 133.26, 133.37, 133.62, 133.86, 134.42, 134.86, 134.98, 135.37, 135.84, 135.94, 136.80, 145.86, 145.94, 146.00, 146.06, 146.22, 146.31, 154.27, 154.95.

Synthesis of cavitand (±)-16 ($C_{11}H_{23}$) and (*Ra*)-16 ($C_{11}H_{23}$)

m-Chloroperoxybenzoic acid (33 mg, 0,1335 mmol) was added to a solution of cavitand **15** (0.0334 mmol) in $CHCl_3$ (5 mL). The mixture was stirred at room temperature for 2 h. After evaporation of the solvent, the crude compound was purified by silica gel column chromatography (eluent CH_2Cl_2 to CH_2Cl_2/THF 95:5 to CH_2Cl_2/THF/Acetone 9:1) to give compound **16** as a white solid (91%).

Compound 16



LSIMS *m/z* 1749.9256 [M + H]+ (calc. 1749.9217)

^{31}P NMR ($CDCl_3$, 300 K, 202.45 MHz): 7.93, 8.08, 8.67

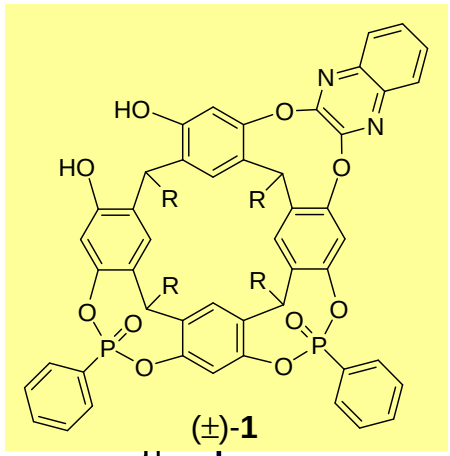
^{1}H NMR ($CDCl_3$, 300 K, 200.13 MHz): 0.87 (m, 12H), 1.15-1.44 (m, 72H), 1.90 (m, 1H), 2.10 (m, 1H), 2.19-2.34 (m, 6H), 4.19 (d, 1H, J = 9.0 Hz), 4.60 (d, 1H, J = 12.3 Hz), 4.67 (t, 1H, J = 7.5 Hz), 4.75 (t, 2H, J = 7.4 Hz), 4.88 (d, 1H, J = 9.1 Hz), 4.95 (t, 1H, J = 8.4 Hz), 5.01 (d, 1H, J = 12.1 Hz), 6.52 (s, 1H), 6.92 (d, 1H, J = 5.0 Hz), 6.94 (d, 1H, J = 5.0 Hz), 7.00 (s, 1H), 7.08 (s, 1H), 7.12-7.22 (m, 4H), 7.29-7.35 (m, 2H), 7.37 (t, 1H, J = 7.5 Hz), 7.43-7.52 (m, 5H), 7.57-7.62 (m, 4H), 7.67 (t, 1H, J = 7.2 Hz), 7.74 (d, 1H, J = 8.6 Hz), 7.79 (d, 1H, J = 8.3 Hz), 7.82 (d, 1H, J = 8.6 Hz), 7.93 (q, 2H, J = 8.6 Hz), 7.98 (d,

2H, J = 7.4 Hz), 8.01 (b, 3H), 8.05 (d, 1H, J = 8.3 Hz) 8.17 (d, 1H, J = 8.3 Hz), 8.20 (d, 1H, J = 8.3 Hz).

^{13}C NMR ($CDCl_3$, 298 K, 125.76 MHz): δ 174.23, 155.74, 146.62, 146.53, 146.10, 146.02, 145.80, 145.72, 145.66, 145.58, 136.37, 135.67, 135.45, 134.94, 134.47, 133.41, 133.24, 133.22, 133.15, 133.04, 132.40, 131.91, 131.80, 131.75, 131.73, 131.69, 131.61, 129.50, 128.96, 128.66, 128.53, 128.43, 128.31, 128.16, 127.95, 127.59, 127.24, 126.52, 126.48, 126.45, 126.31, 126.15, 126.07, 123.85, 123.79, 121.65, 117.44, 117.00, 106.51, 106.31, 70.10, 68.22, 68.15, 65.29, 63.24, 35.92, 35.84, 34.82, 34.16, 32.00, 31.96, 31.94, 31.88, 31.43, 30.98, 30.91, 30.76, 29.84, 29.75, 29.73, 29.71, 29.66, 29.57, 29.47, 29.43, 29.42, 29.40, 29.37, 29.27, 29.15, 28.02, 27.99, 27.90, 27.77, 24.91, 22.73, 22.70, 22.69, 14.14, 14.12, 14.11.

$[\alpha]_D^{20}$ = 112 ° (c ~ 0.1 in acetone)

*Figure S1: ^1H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**1***



(±)-**1**

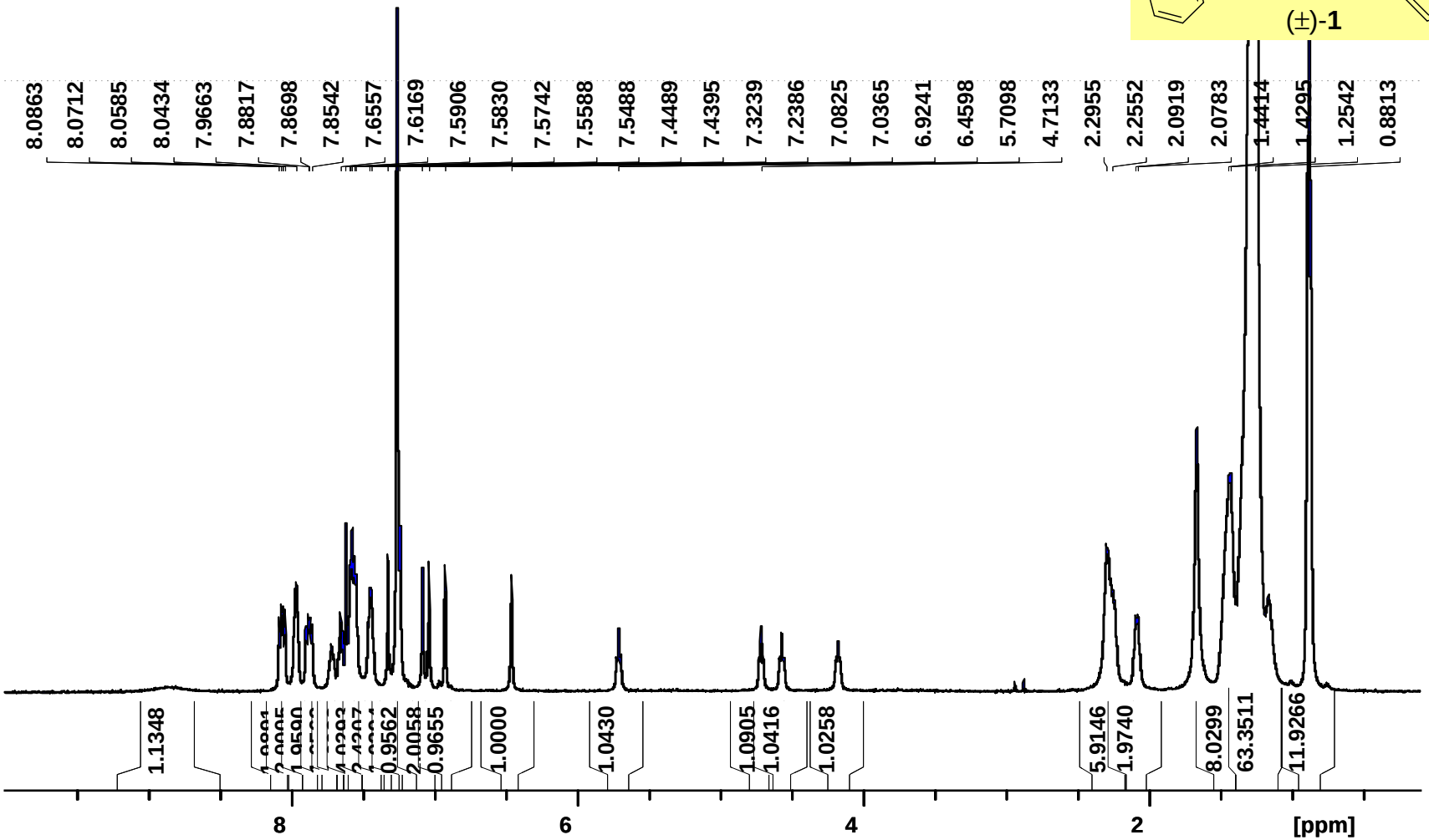
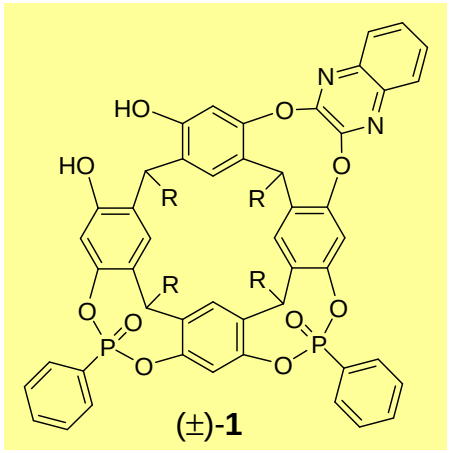


*Figure S2: ^{1}H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**1***



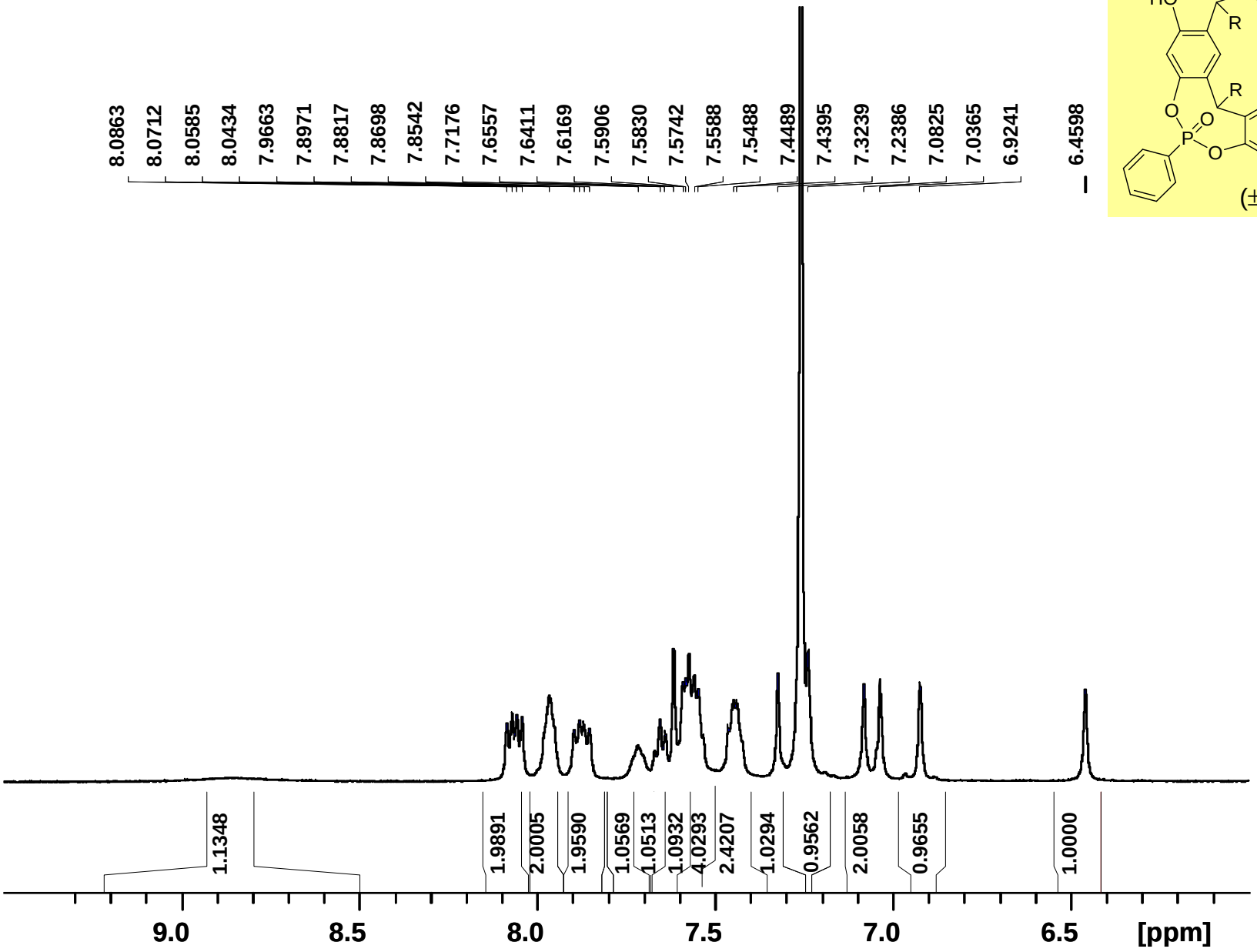
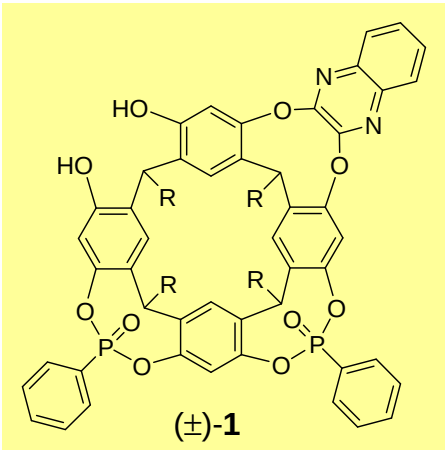


*Figure S3: ^1H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**1***



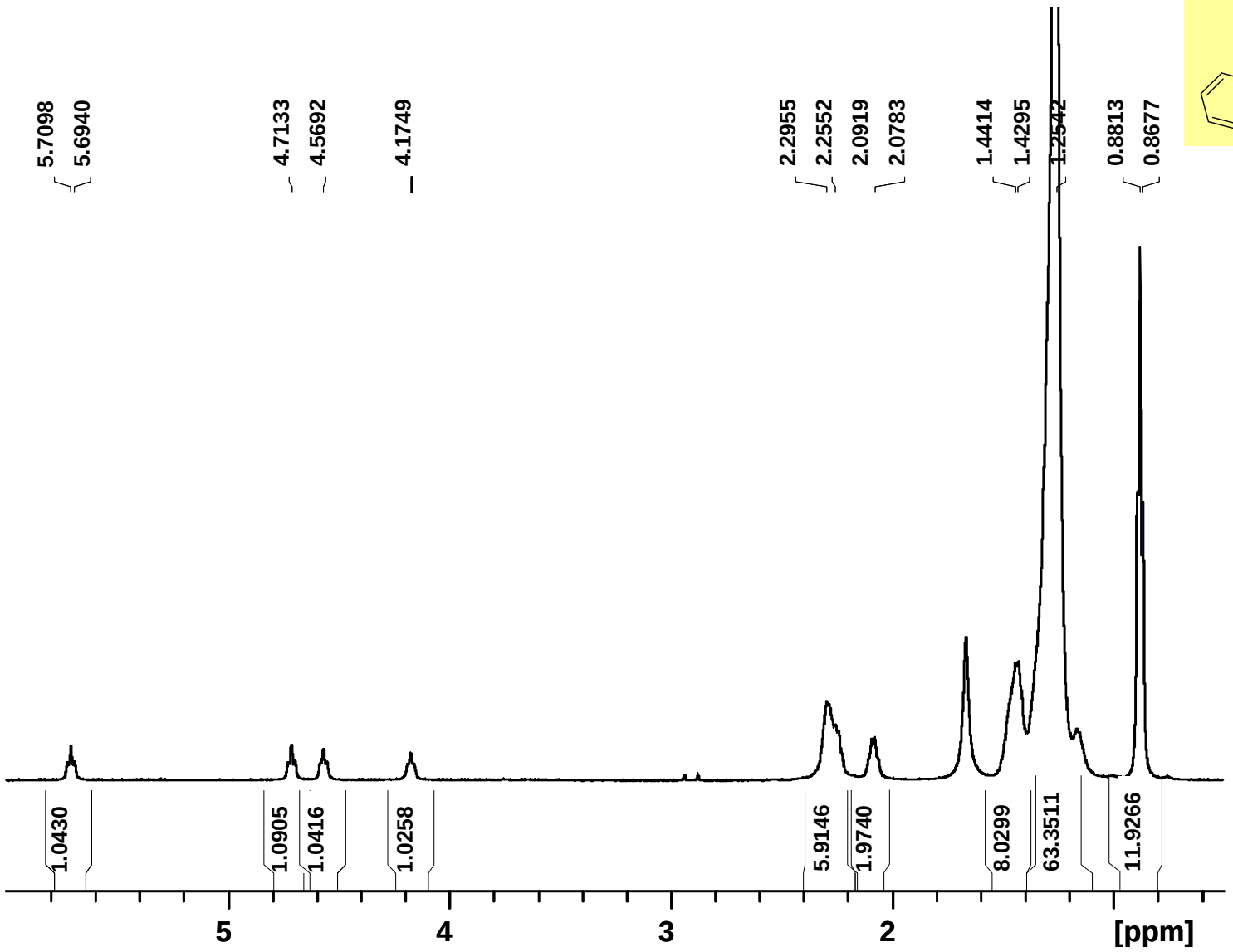
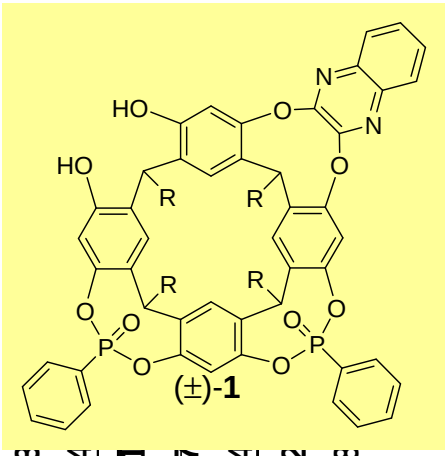


*Figure S4: ^{13}C NMR ($CDCl_3$, 125.75 MHz, 293K) of (±)-**1***



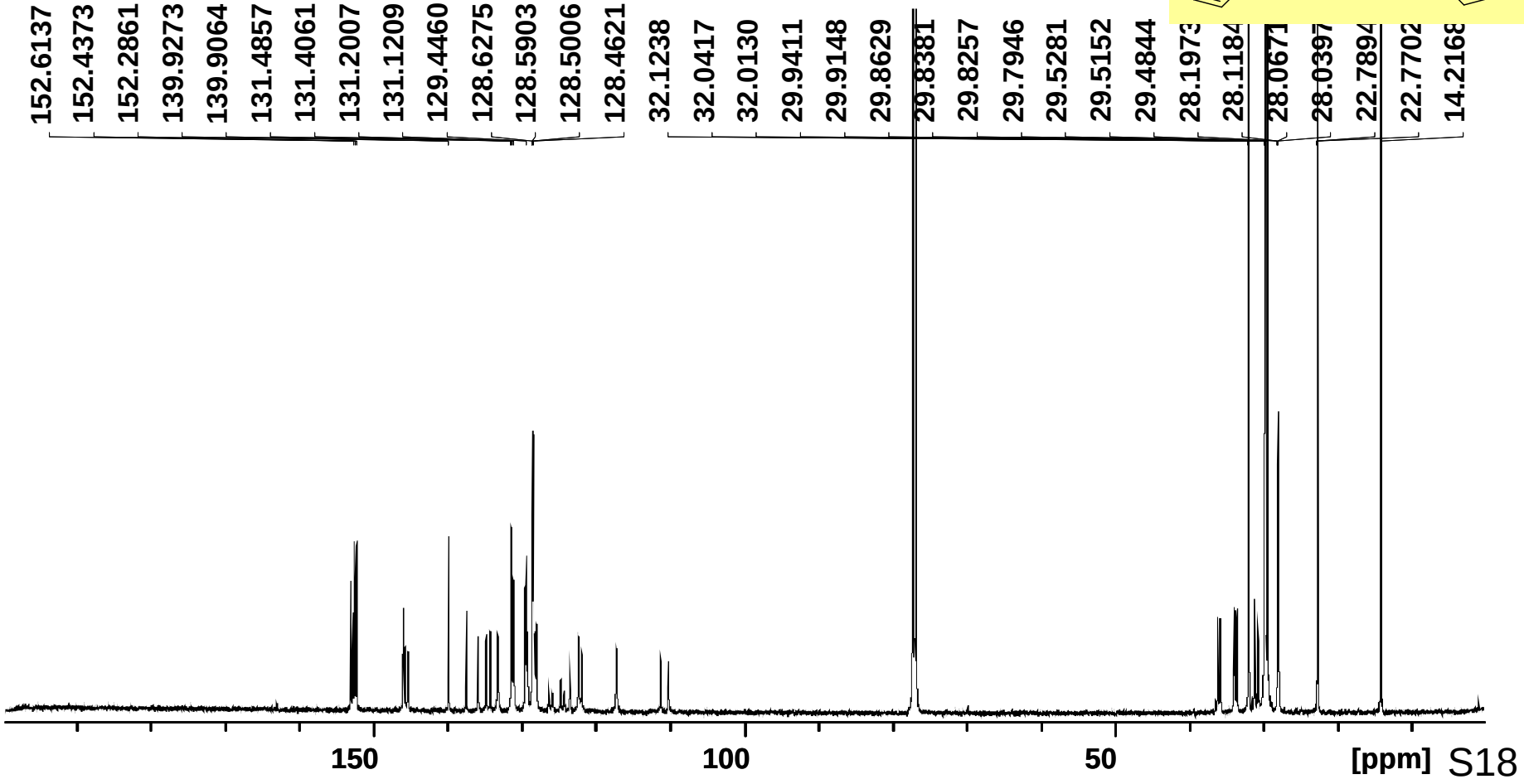
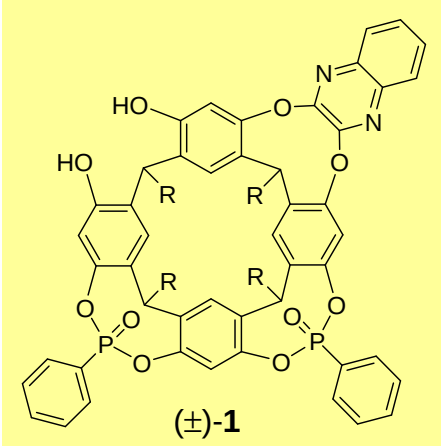


*Figure S5: ^{13}C NMR ($CDCl_3$, 125.75 MHz, 293K) of (±)-**1***



(±)-**1**

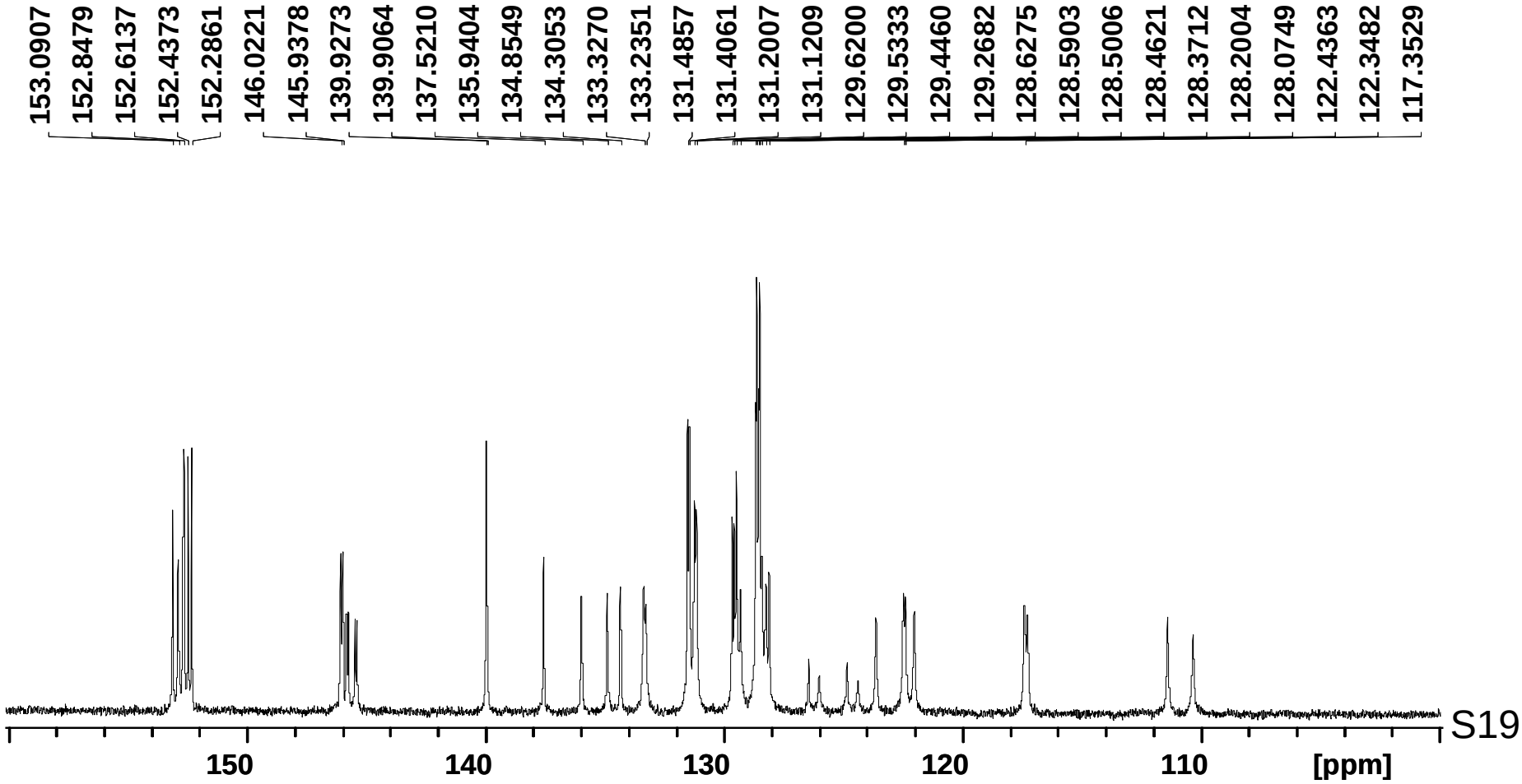
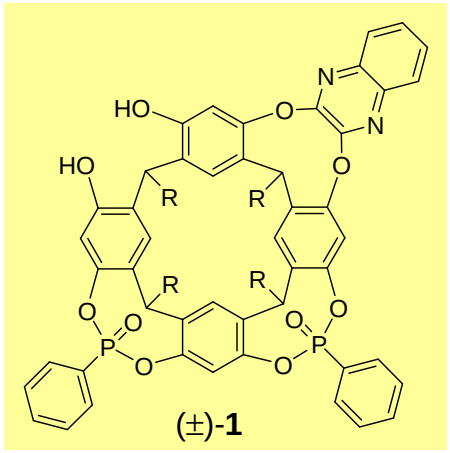


*Figure S6: ^{13}C NMR ($CDCl_3$, 125.75 MHz, 293K) of (±)-**1***



(±)-**1**

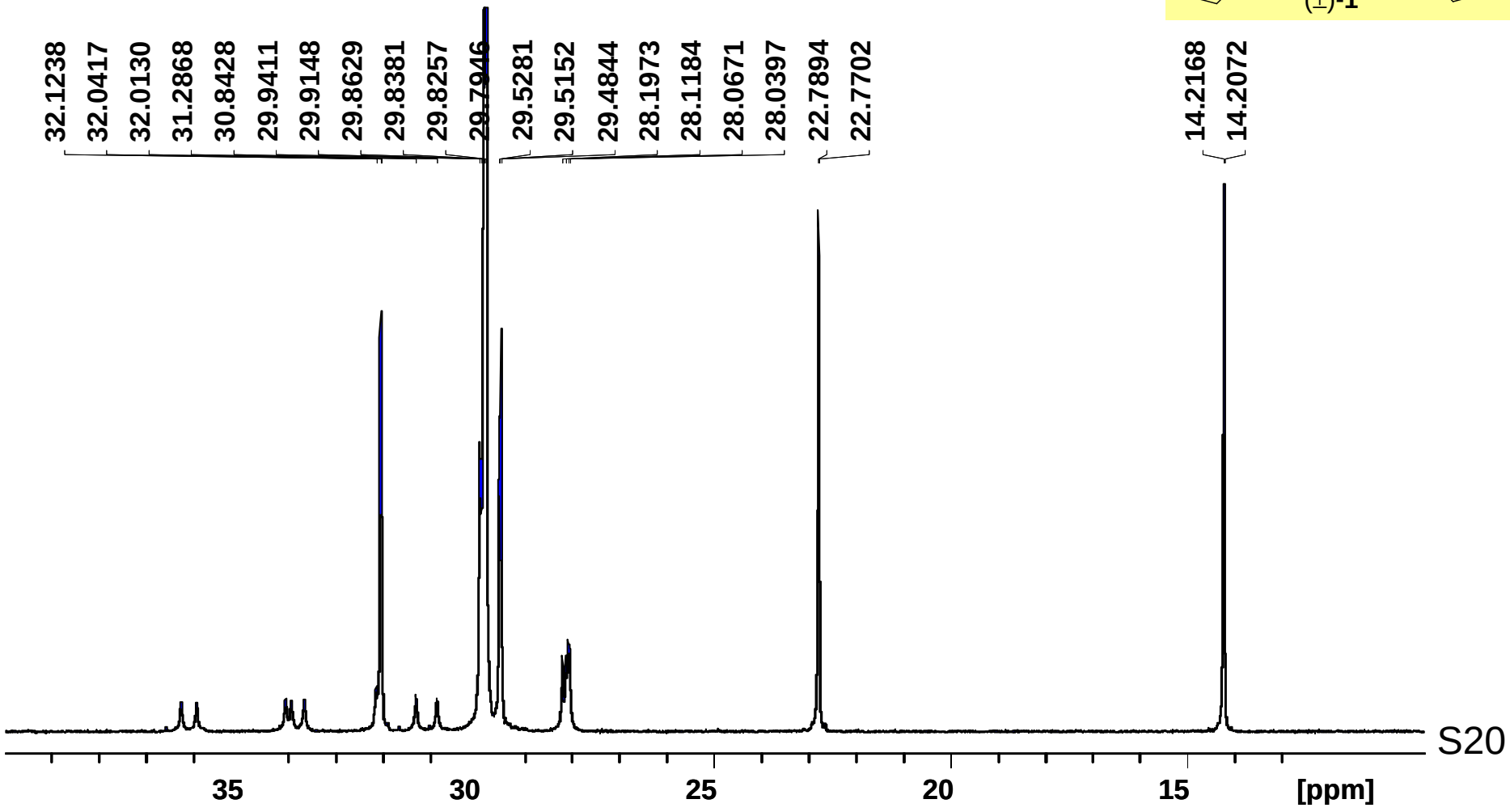
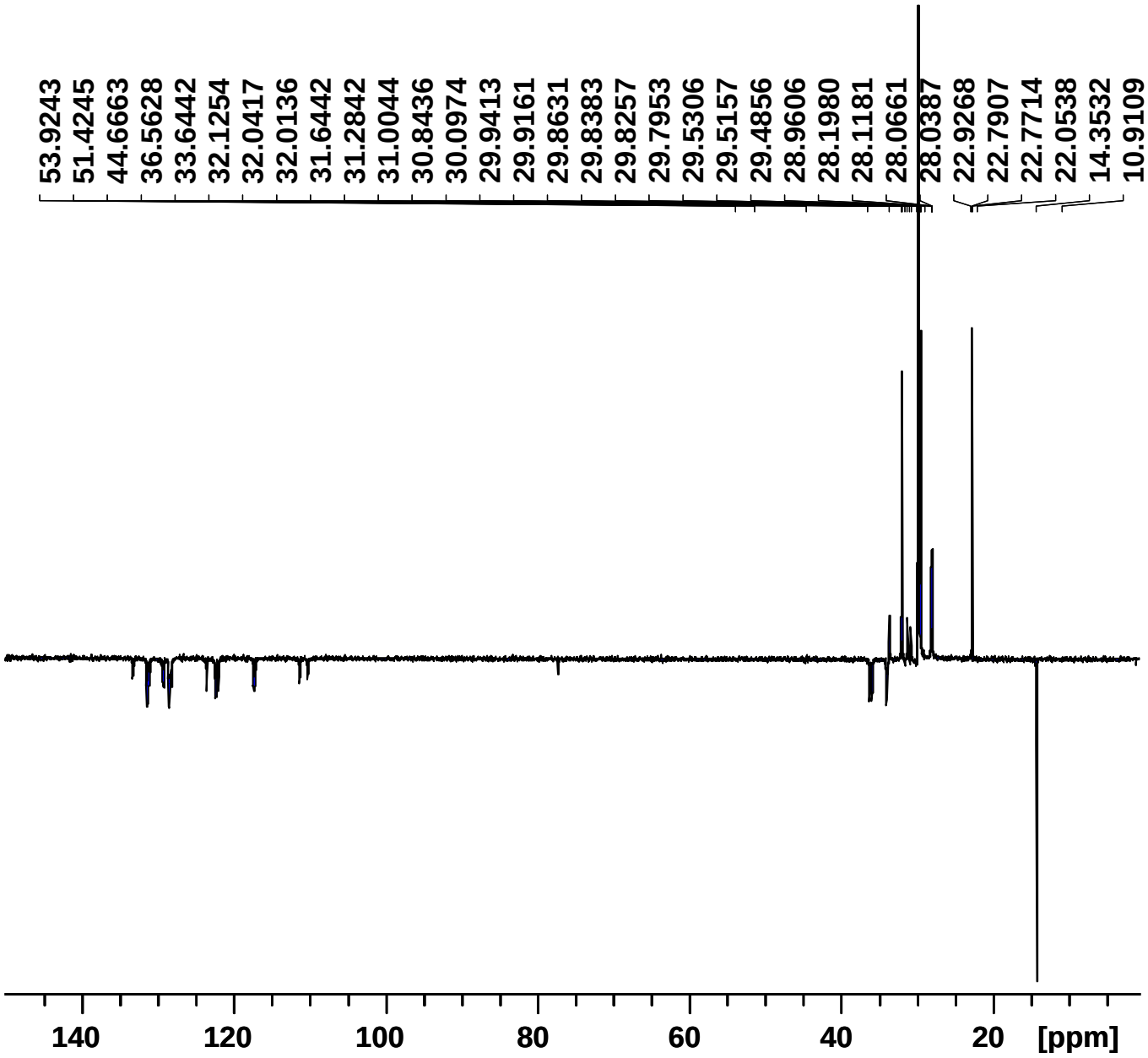


*Figure S7: jmod ($CDCl_3$, 125.75 MHz, 293K) of (±)-**1***



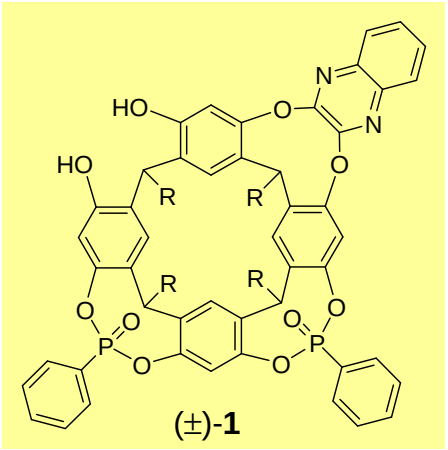
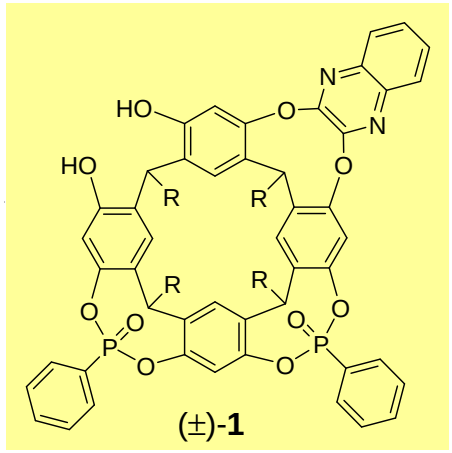


*Figure S8: jmod ($CDCl_3$, 125.75 MHz, 293K) of (±)-**1** (expansion)*



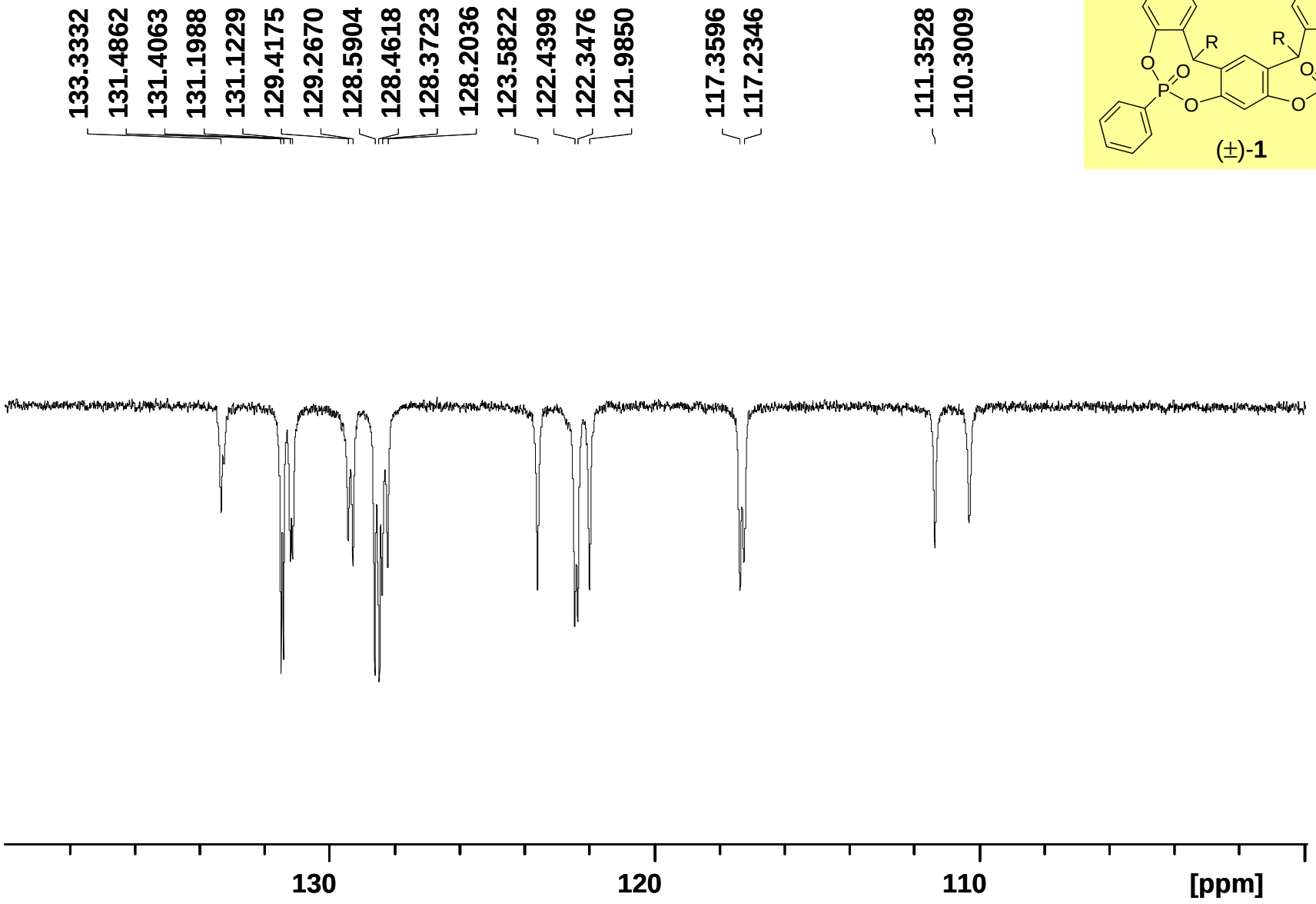
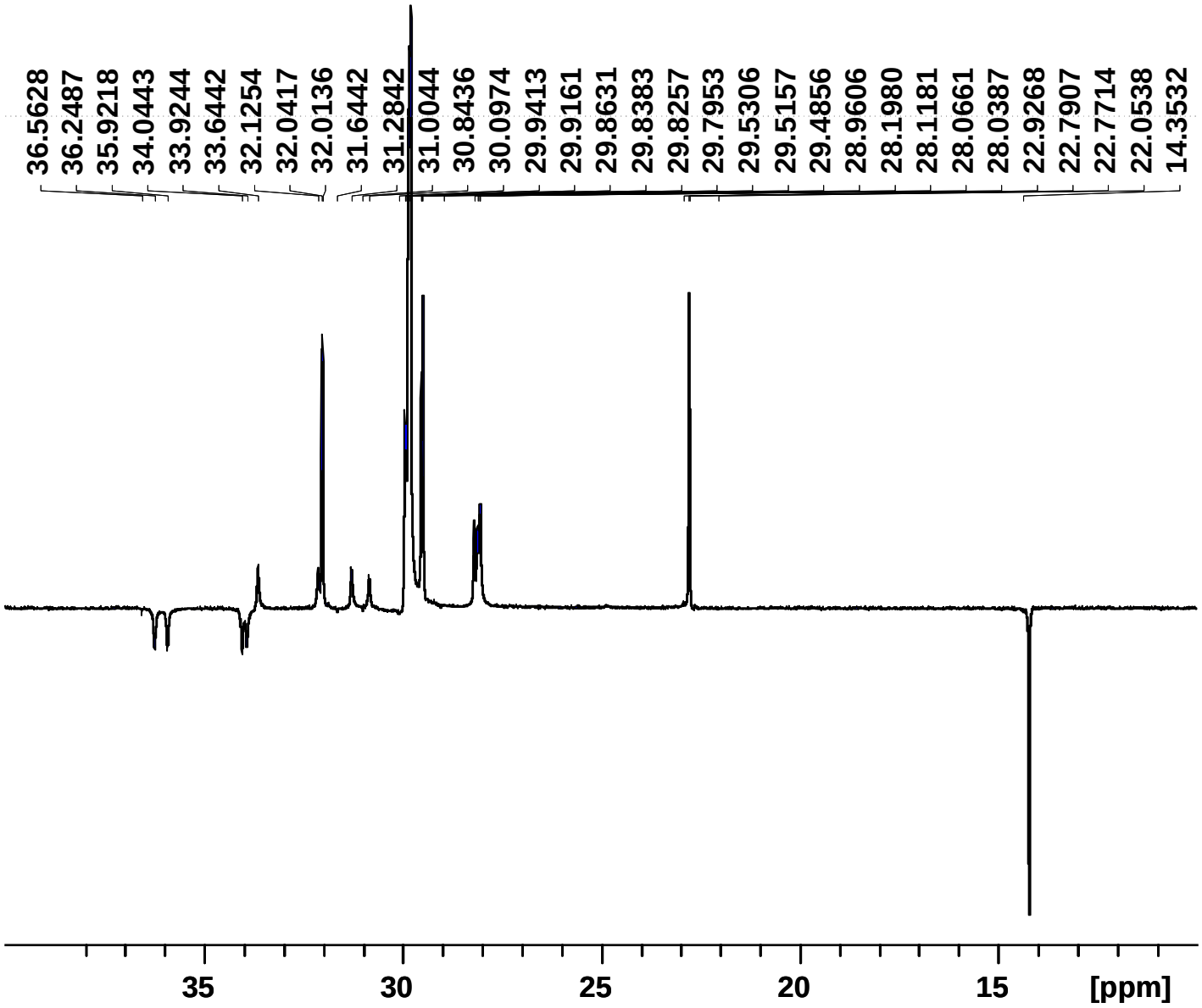


*Figure S9: jmod ($CDCl_3$, 125.75 MHz, 293K) of (±)-**1***



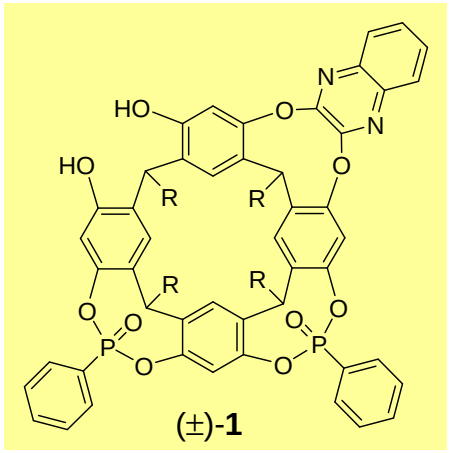
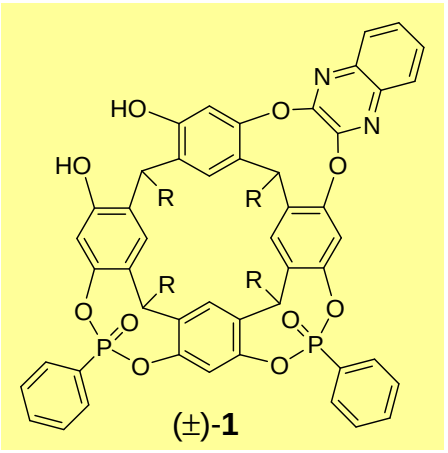


*Figure S10: ^{31}P ($CDCl_3$, 202.45 MHz, 293K) of (±)-**1***



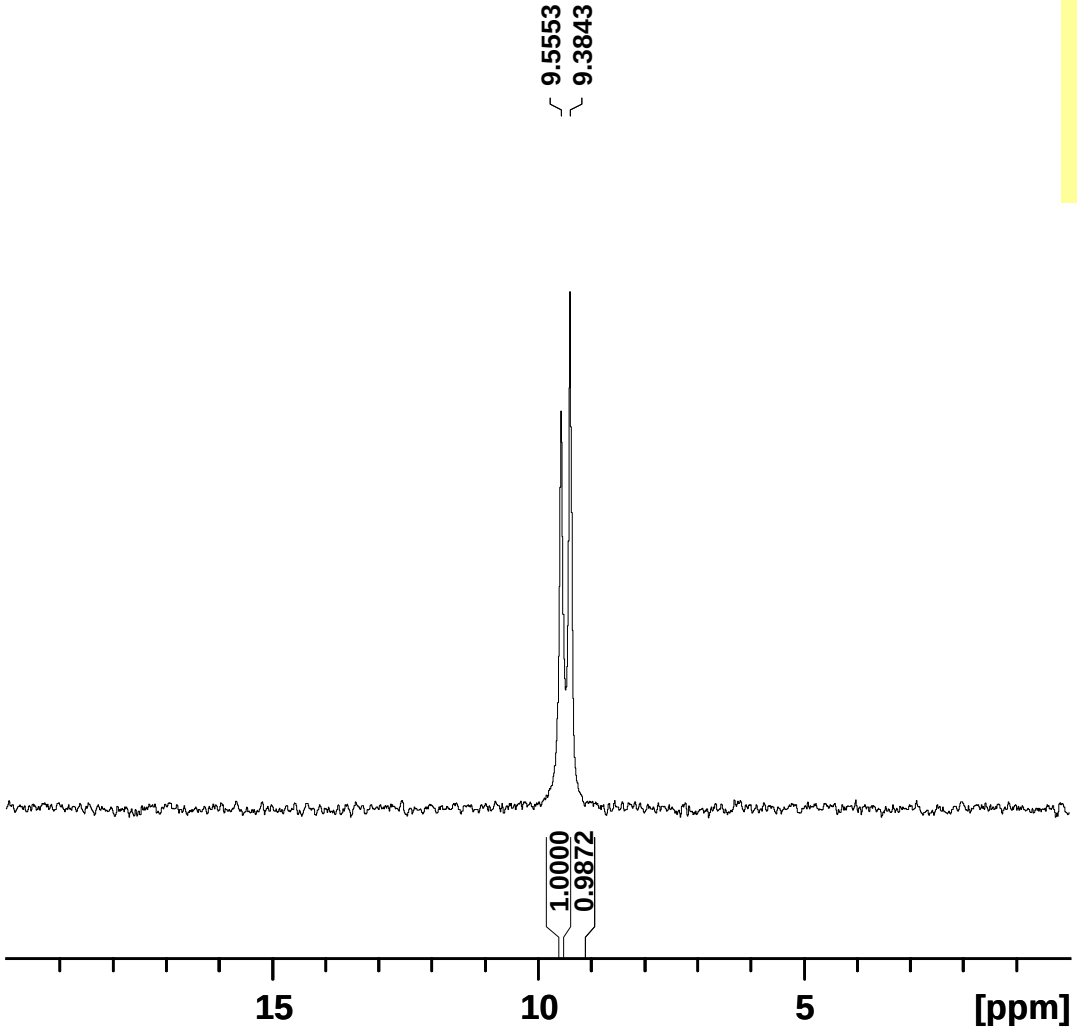
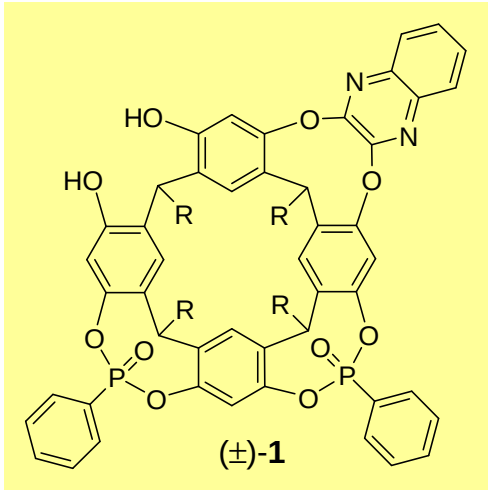


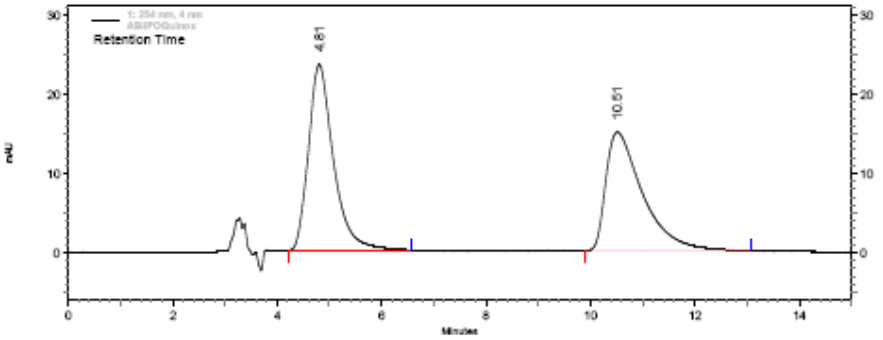
*Figure S11: Optical Resolution of (±)-**1***

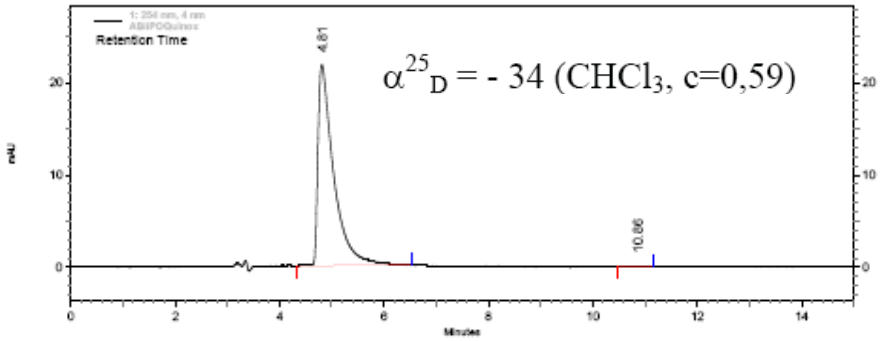


(±)-**1**

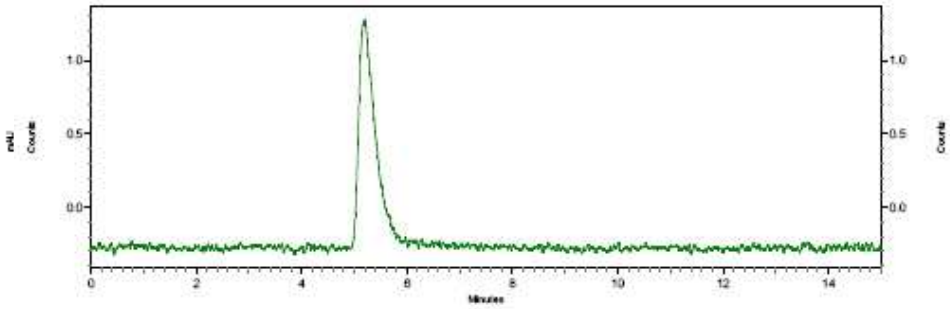
- *Semi-préparative HPLC*

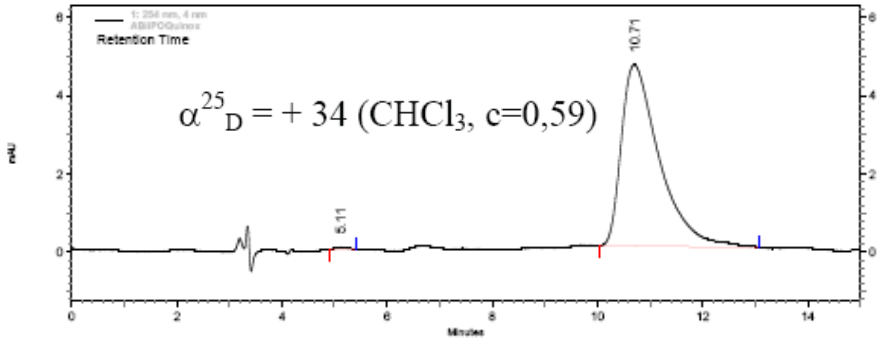
Method description : Chiralpak IC, Hexane/ethanol/chloroforme 80/10/10, 1 ml/min, DAD + CD 277nm





α^{25}_D = - 34 ($CHCl_3$, c=0,59)





α^{25}_D = + 34 ($CHCl_3$, c=0,59)

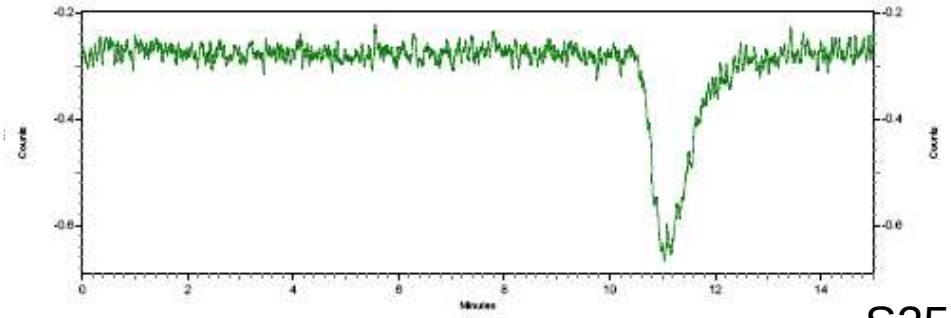


*Figure S12: ^1H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**3***

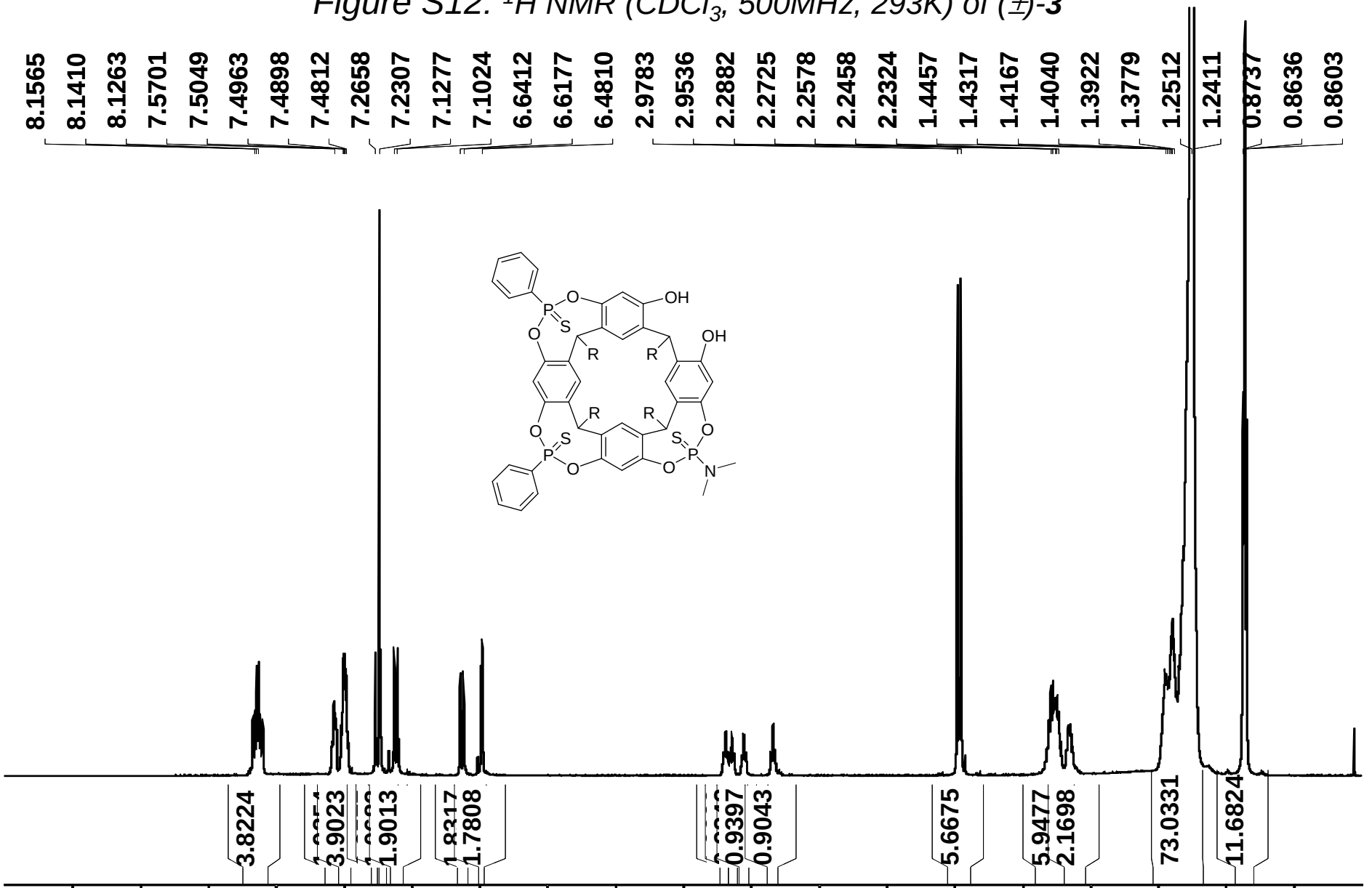


*Figure S13: ^{13}C NMR ($CDCl_3$, 50.32 MHz, 293K) of (±)-**3***

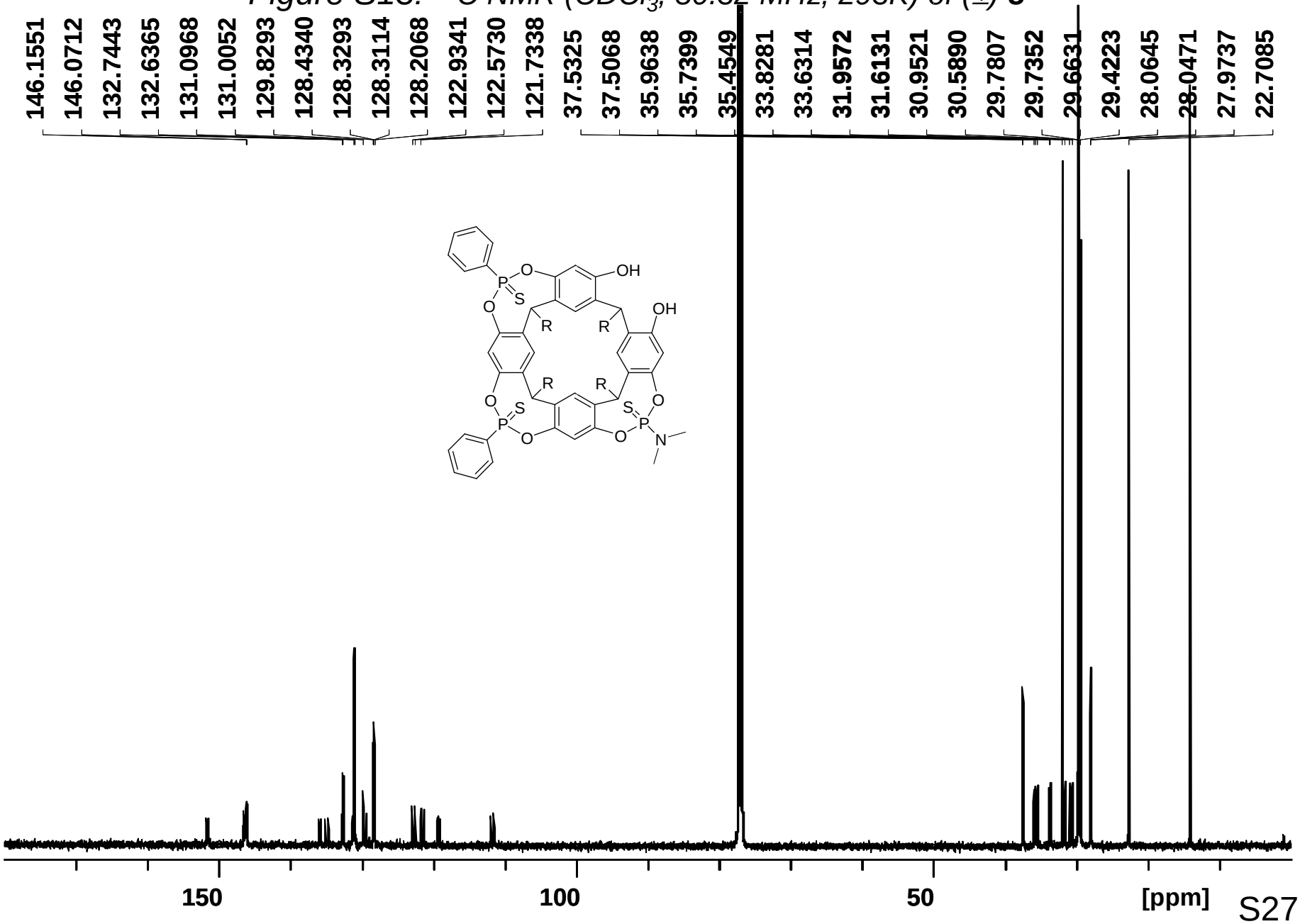


*Figure S14: ^{31}P ($CDCl_3$, 81.01 MHz, 293K) of (±)-**3***

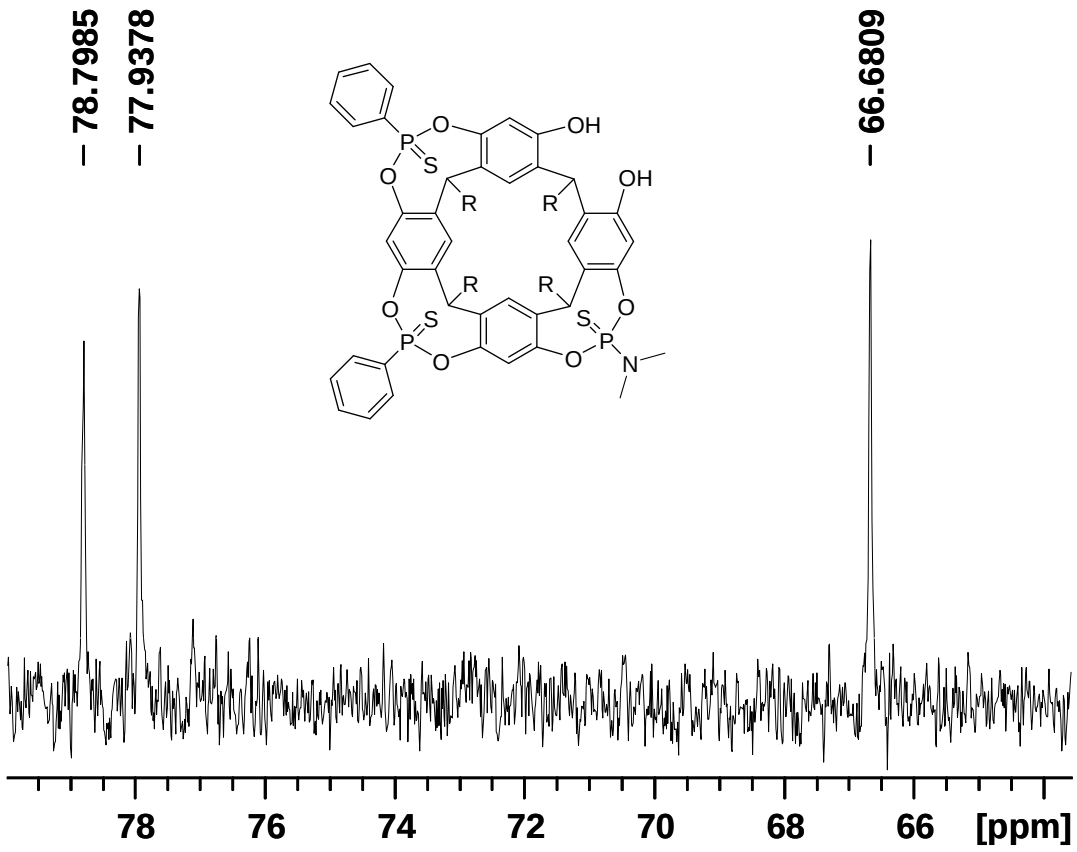


*Figure S15: ^1H NMR ($CDCl_3$, 200MHz, 293K) of (±)-**4***

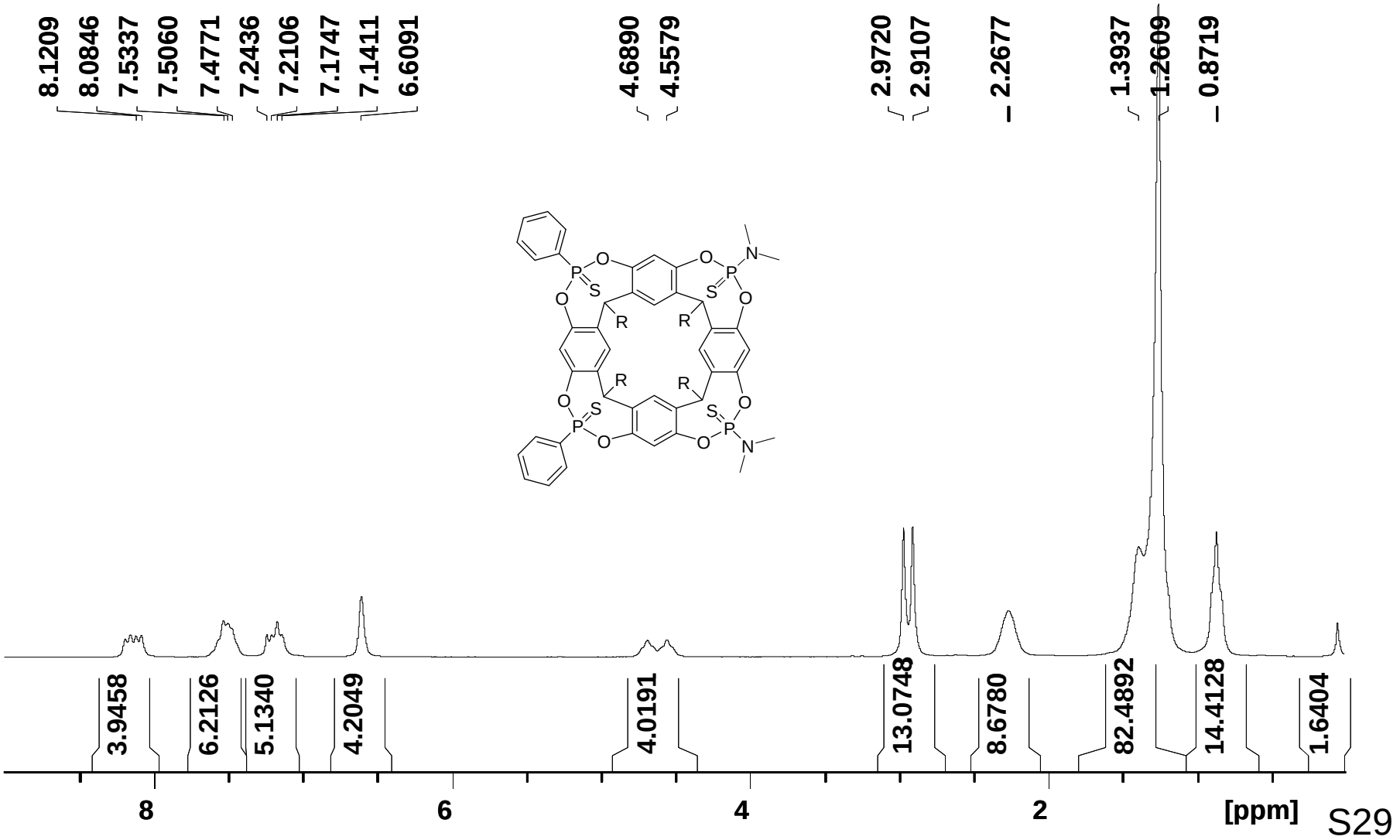


*Figure S16: ^{13}C NMR ($CDCl_3$, 50.32 MHz, 293K) of (±)-**4***

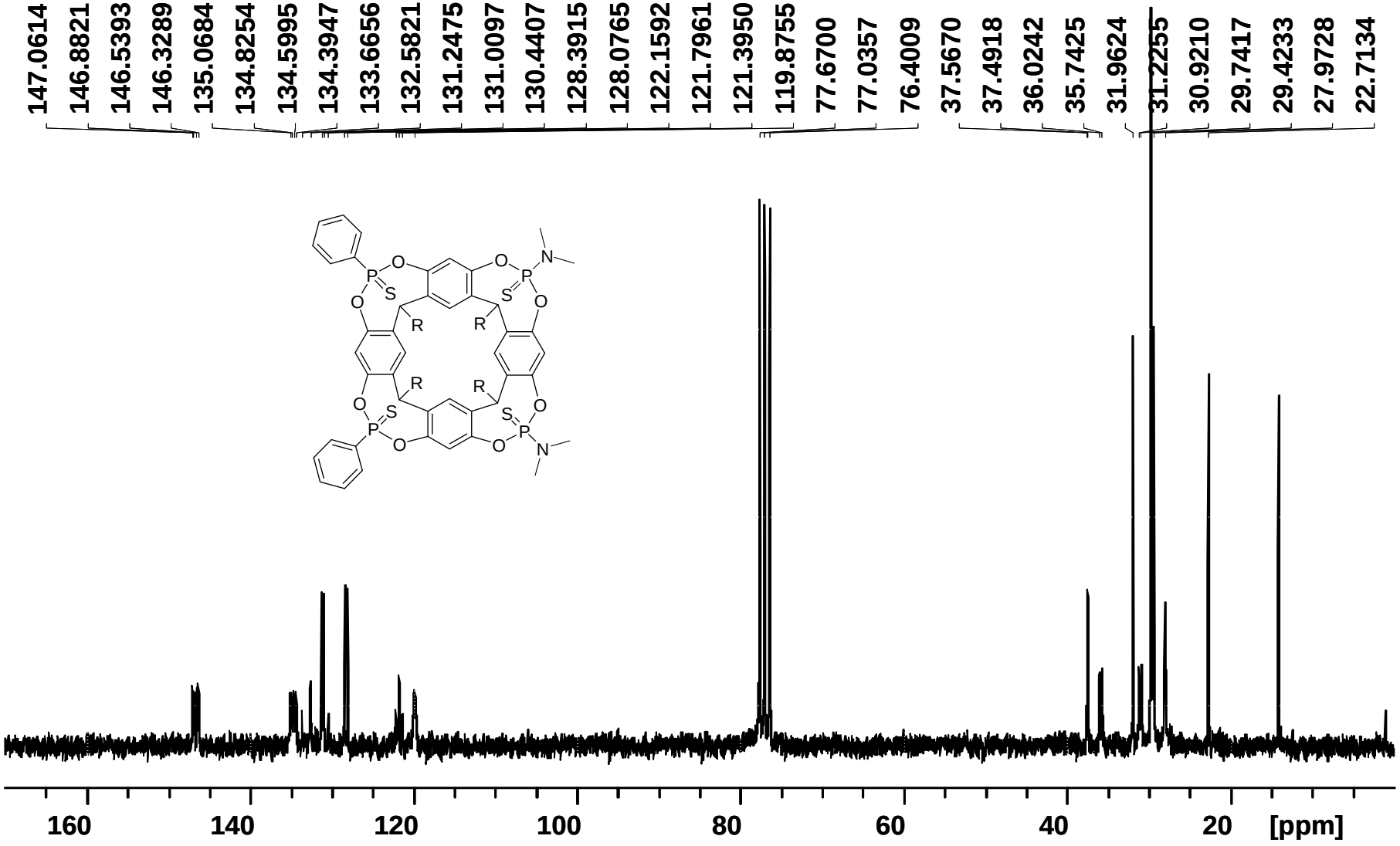


*Figure S17: ^{31}P ($CDCl_3$, 81.01 MHz, 293K) of (±)-**4***

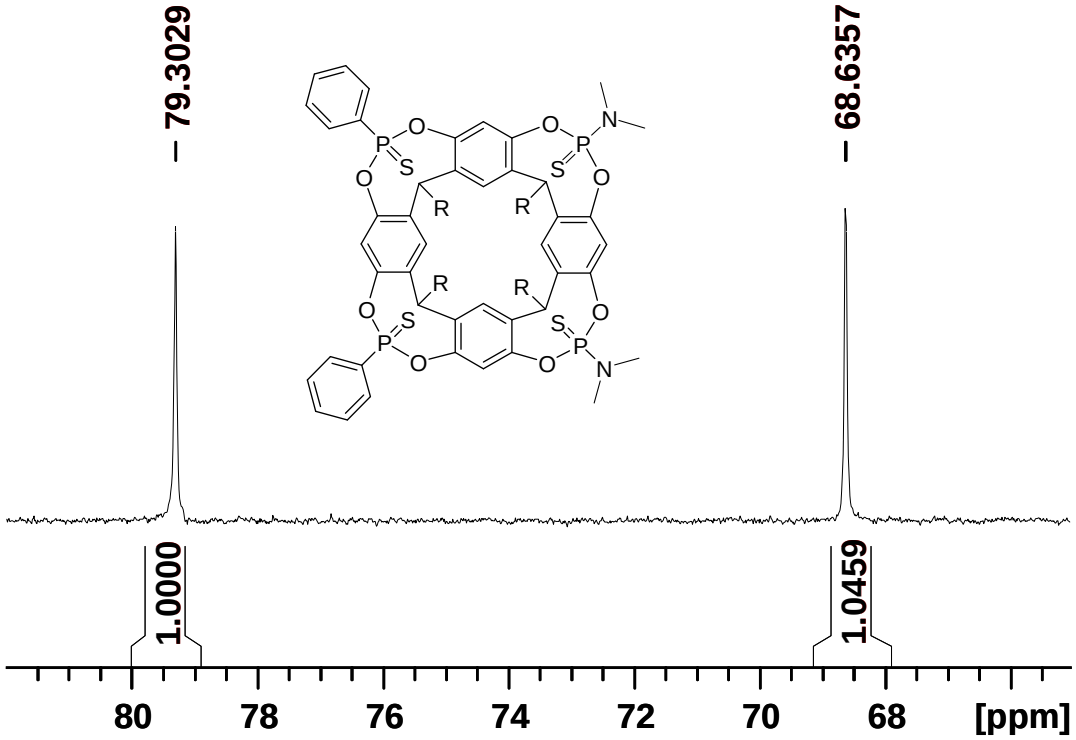


*Figure S18: ^1H NMR ($CDCl_3$, 200MHz, 293K) of (±)-**5***

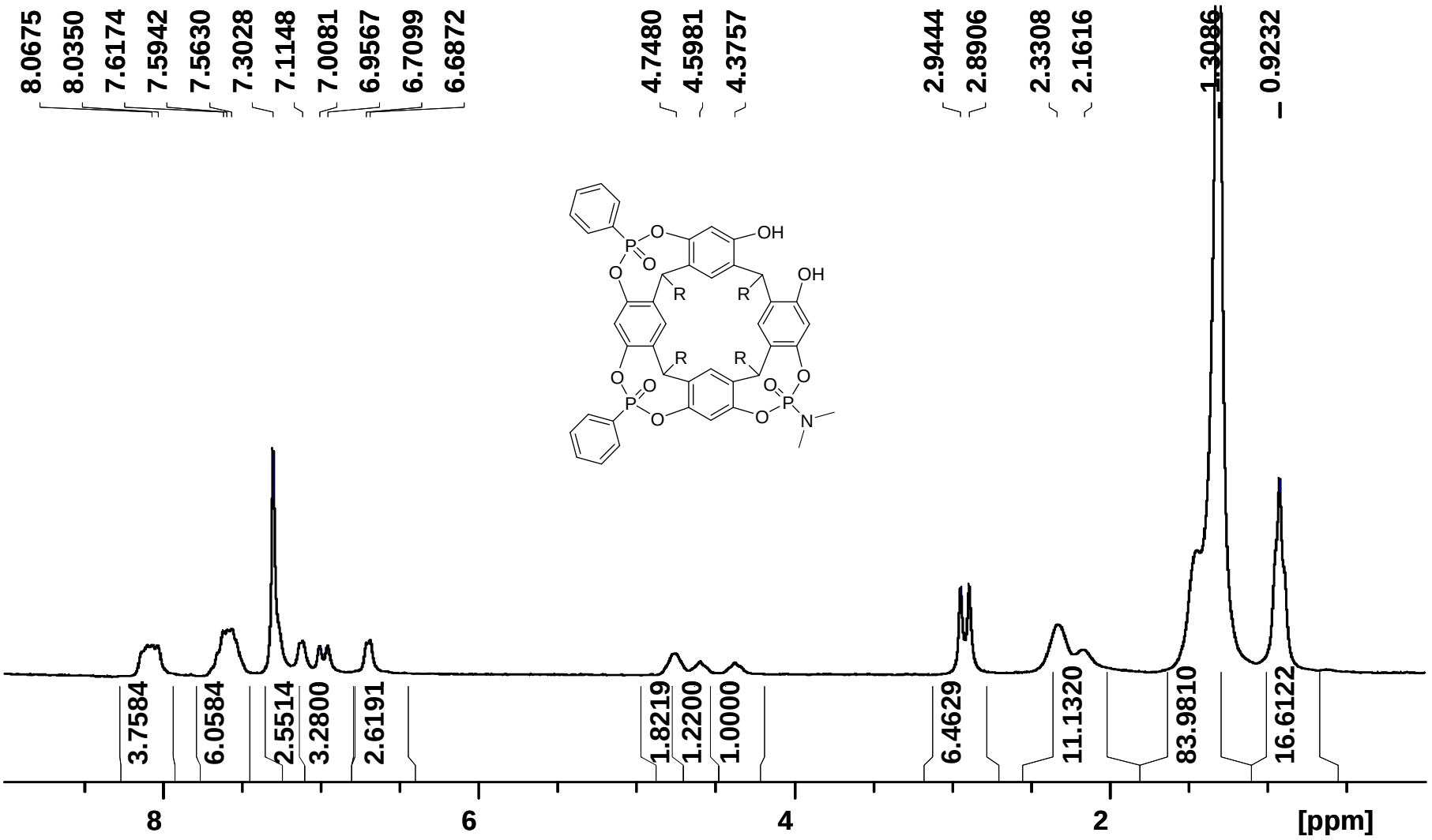


*Figure S19: ^{13}C NMR ($CDCl_3$, 50.32 MHz, 293K) of (±)-**5***

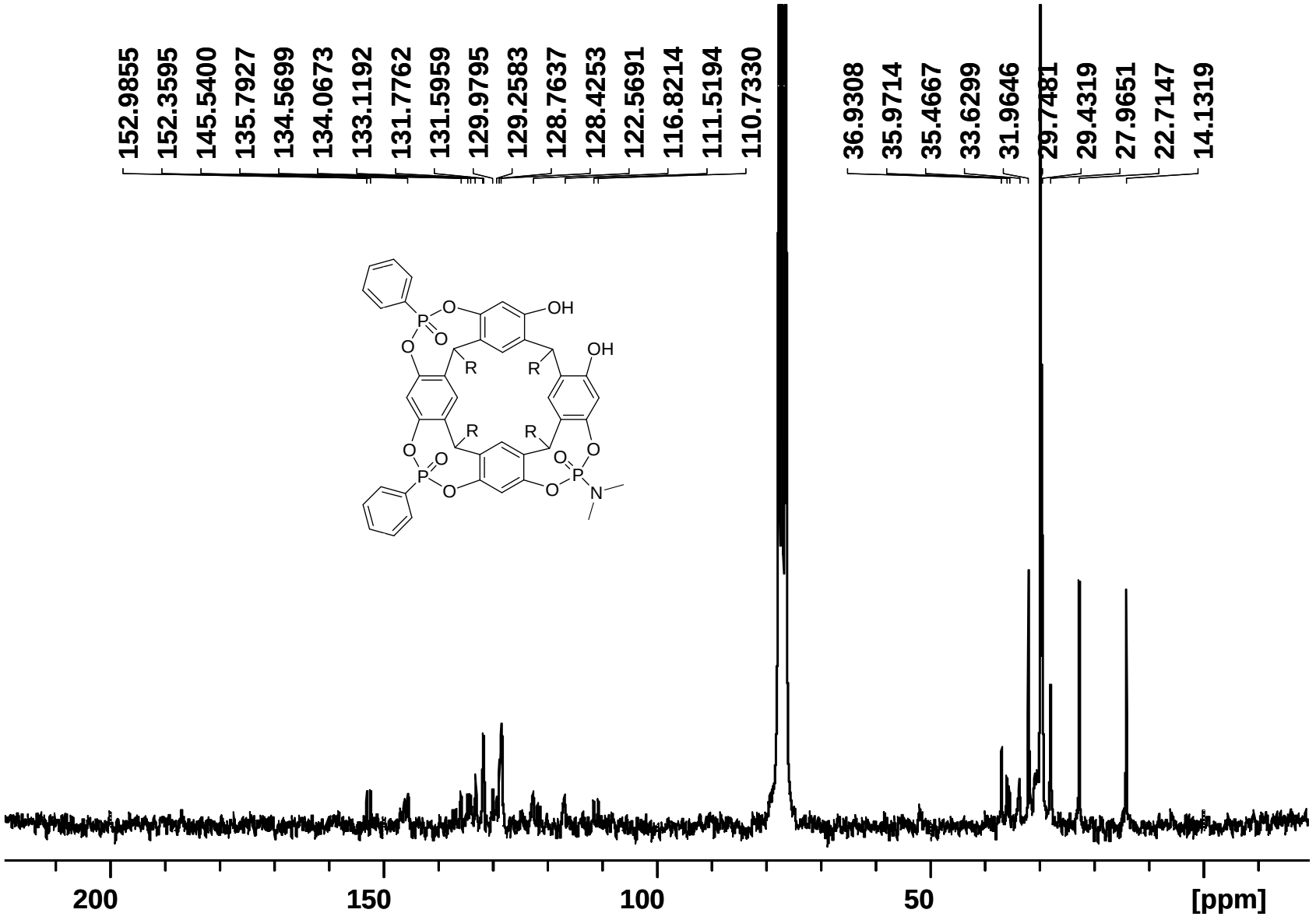


*Figure S20: ^{31}P ($CDCl_3$, 81.01 MHz, 293K) of (±)-**5***

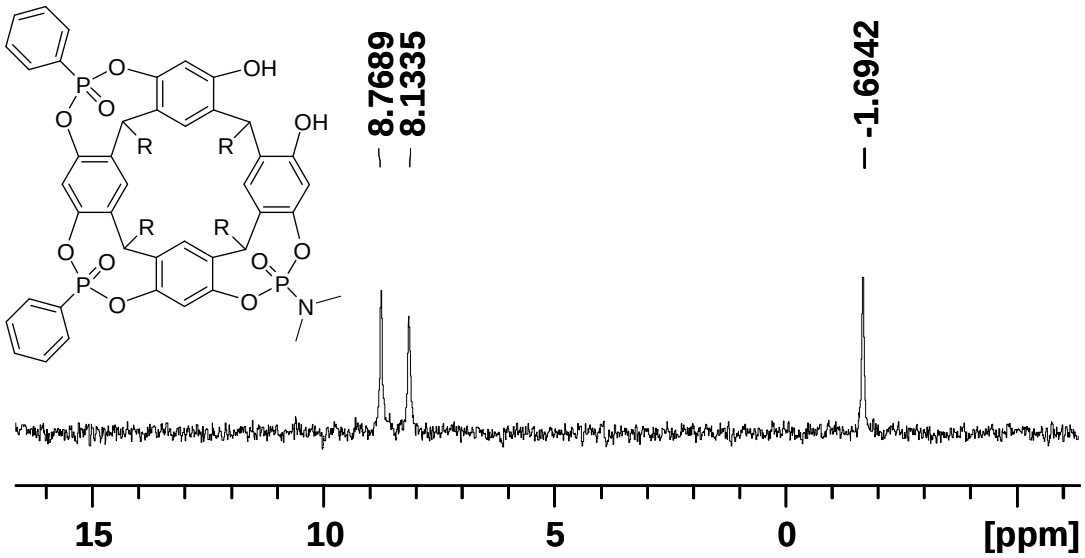


*Figure S21: ^1H NMR ($CDCl_3$, 200MHz, 293K) of (±)-**6***

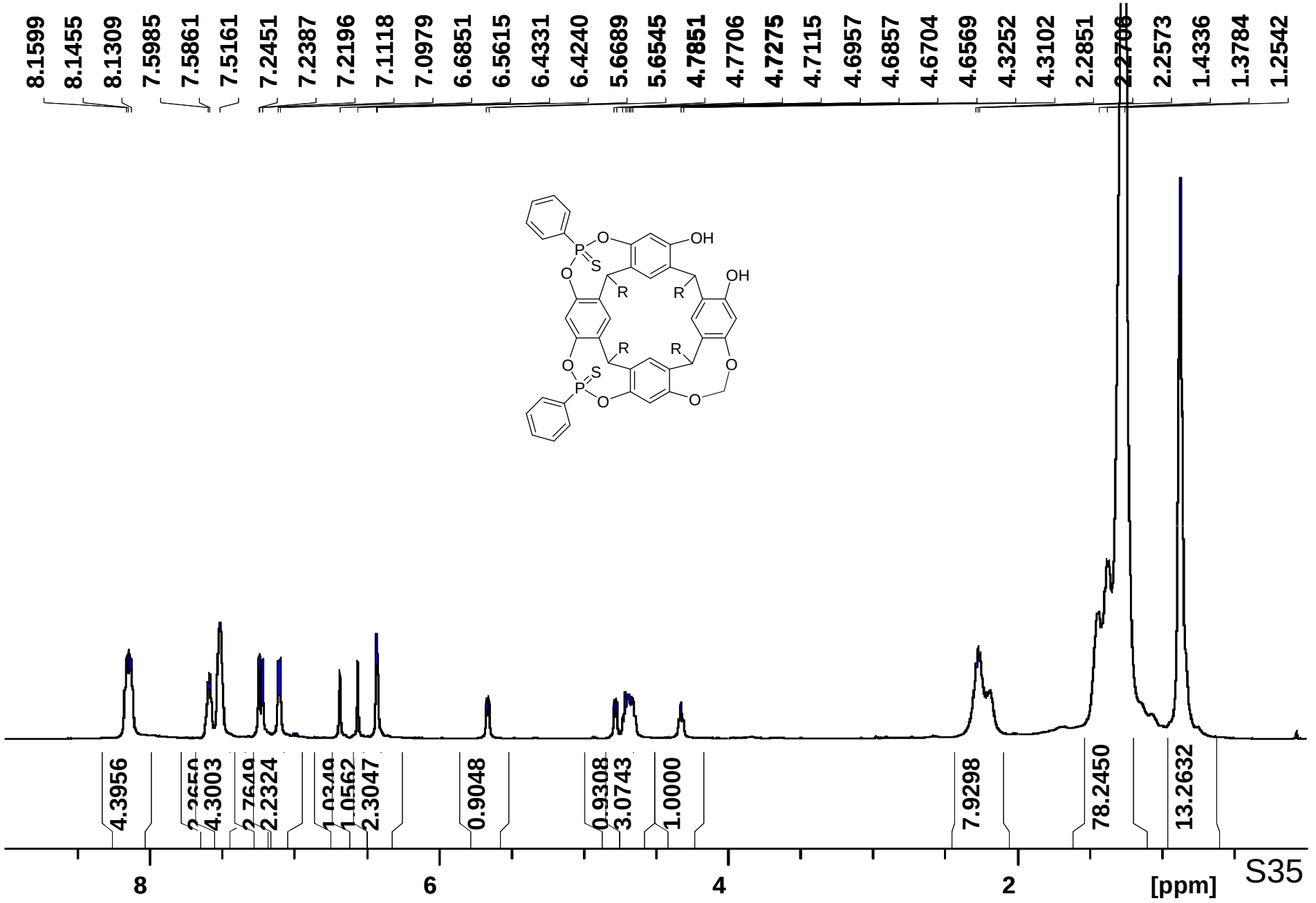


*Figure S22: ^{13}C NMR ($CDCl_3$, 125.75 MHz, 293K) of (±)-**6***

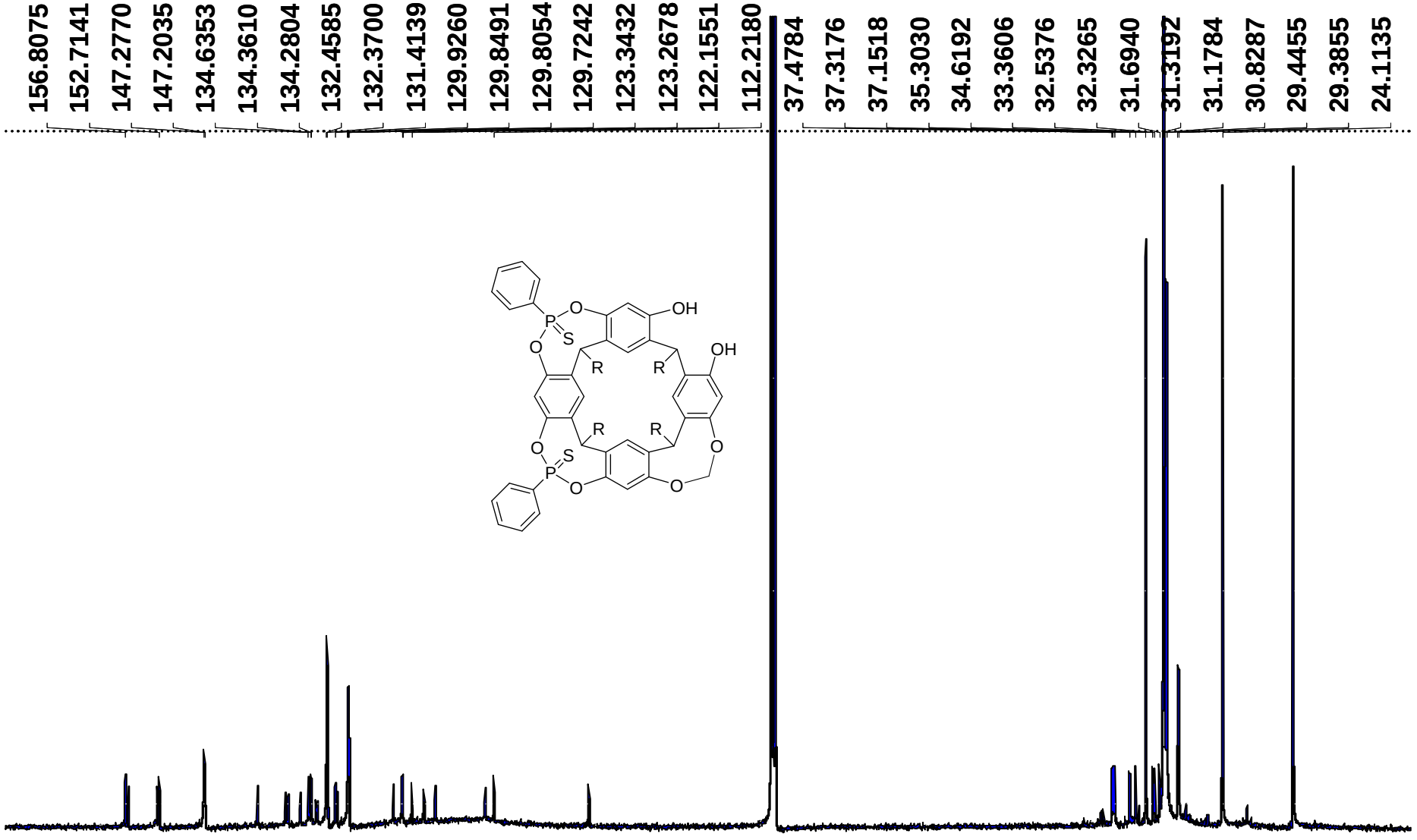


*Figure S23: ^{31}P ($CDCl_3$, 81.01 MHz, 293K) of (±)-**6***

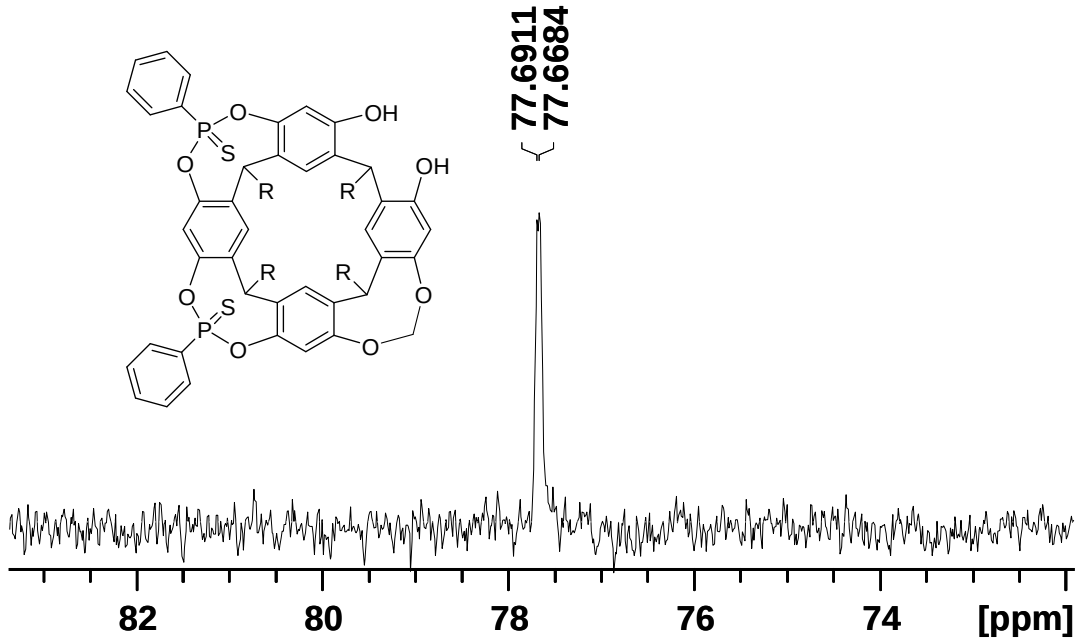


*Figure S24: ^1H NMR ($CDCl_3$, 200MHz, 293K) of **7***

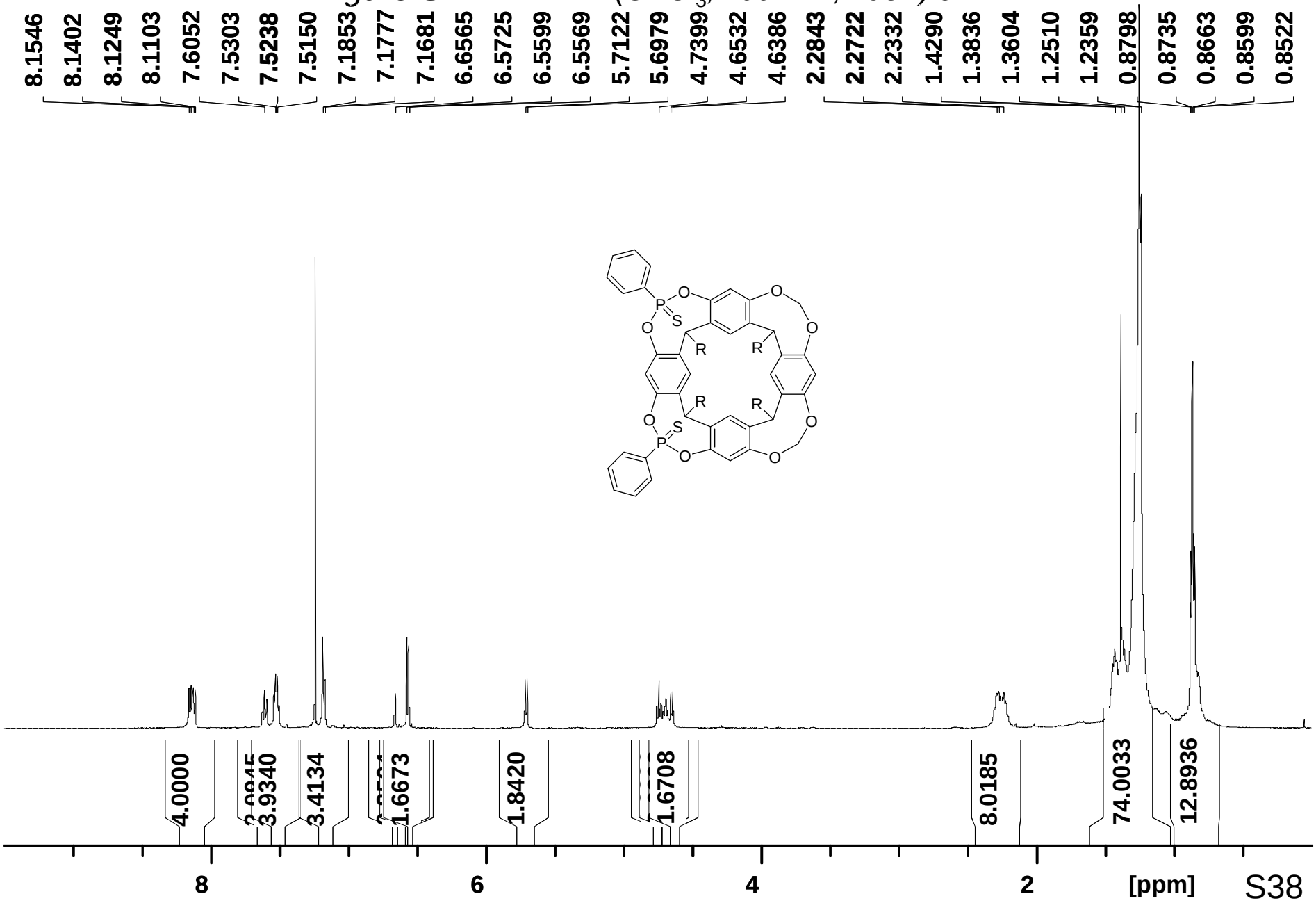


Figure S25: ^{13}C NMR ($CDCl_3$, 125.75 MHz, 293K) of ***7***

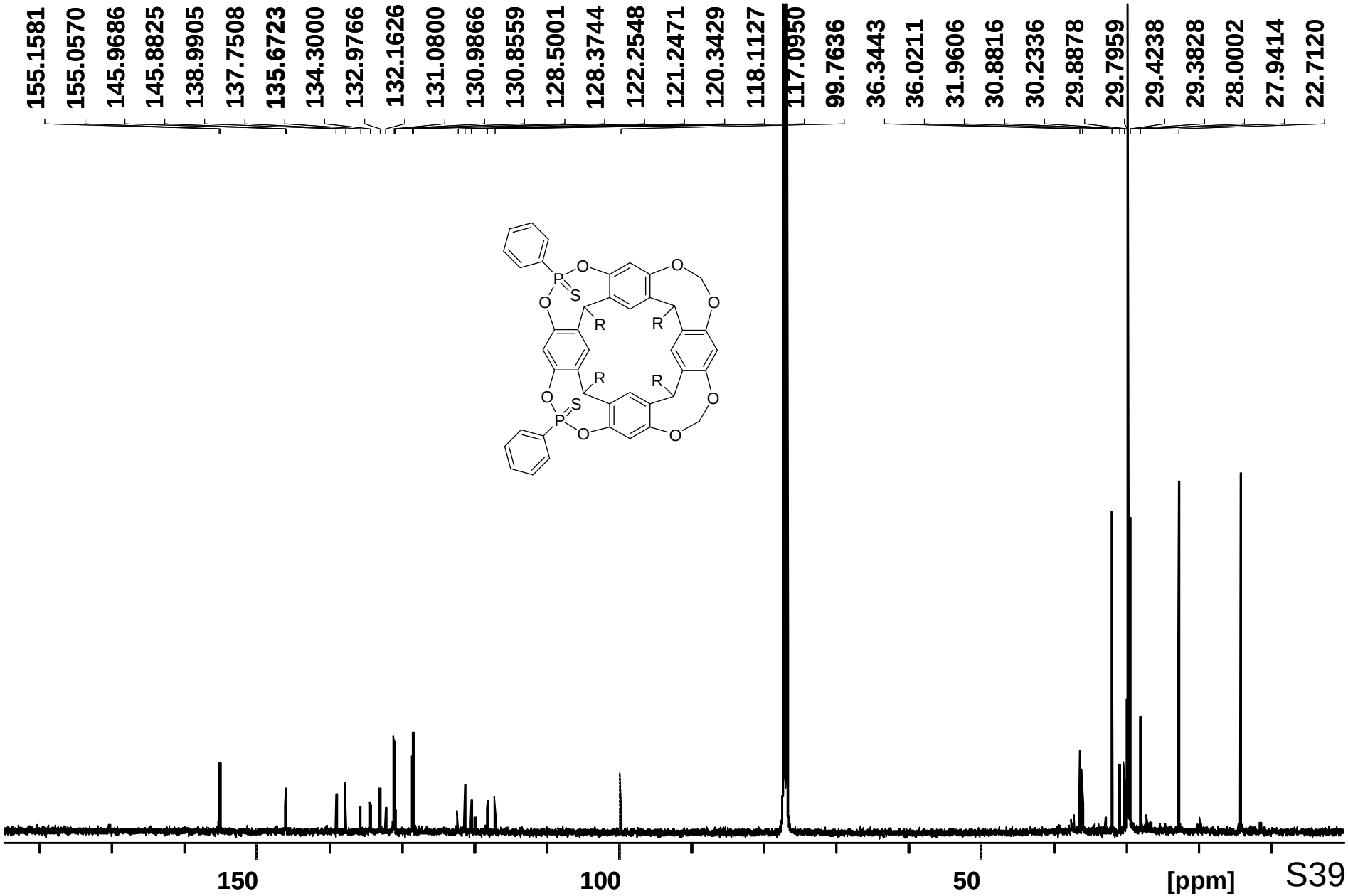


Figure S26: ^{31}P ($CDCl_3$, 81.01 MHz, 293K) of ***7***

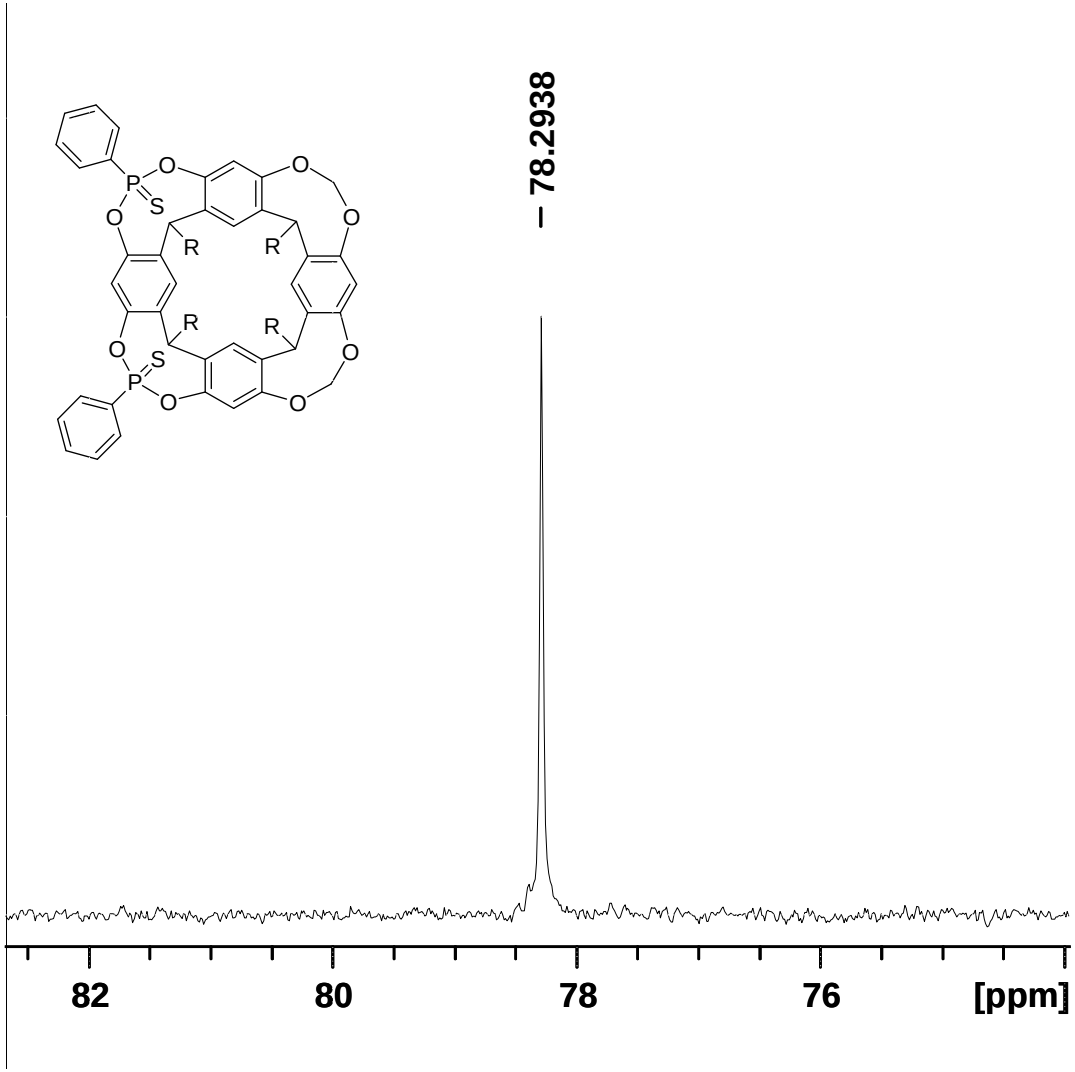


*Figure S27: ^1H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**8***

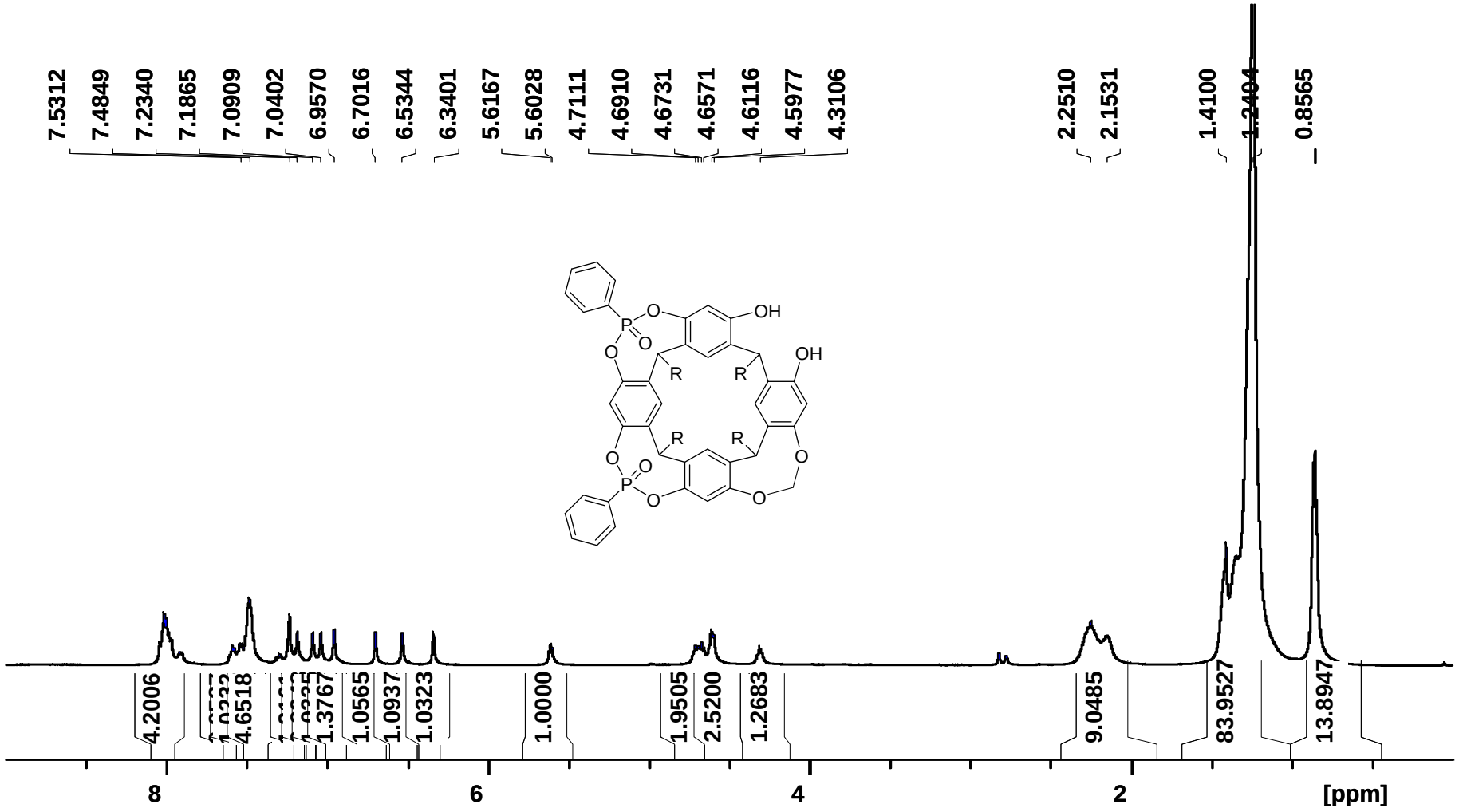


*Figure S28: ^1H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**8** (expansion)*

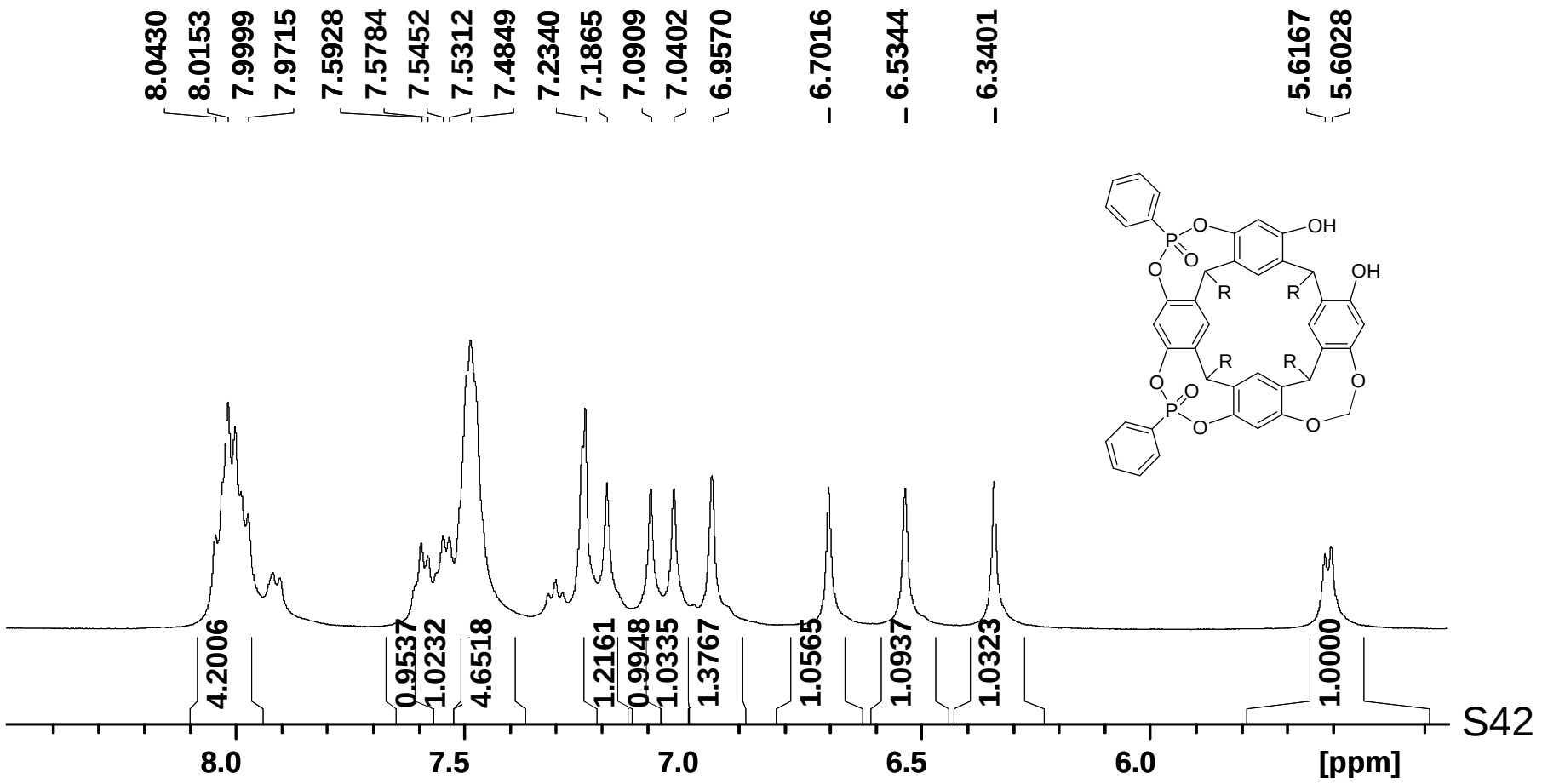


*Figure S29: ^{13}C NMR ($CDCl_3$, 50.32 MHz, 293K) of (±)-**8***

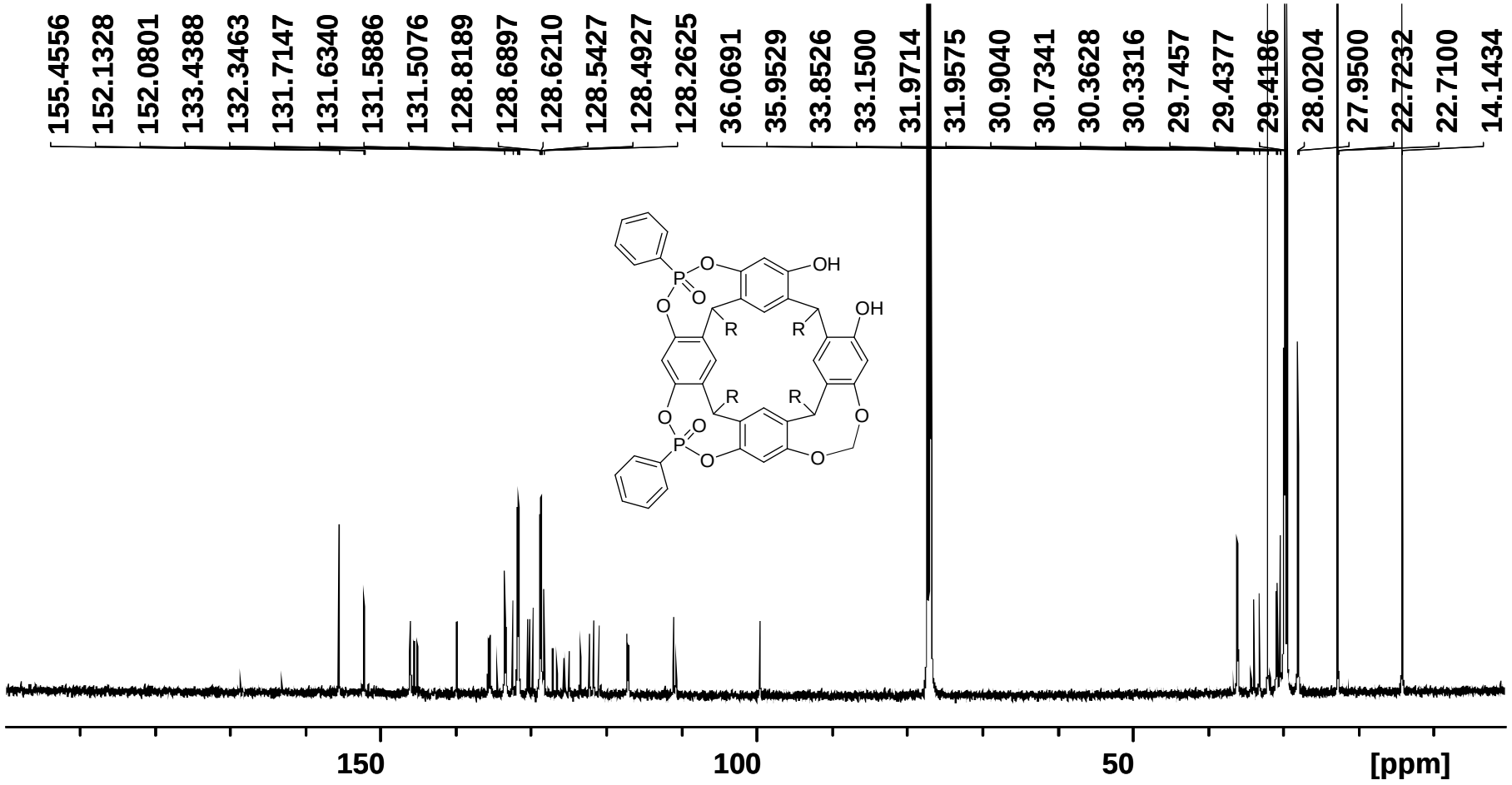


*Figure S30: ^{13}C NMR ($CDCl_3$, 50.32 MHz, 293K) of (±)-**8** (expansion)*

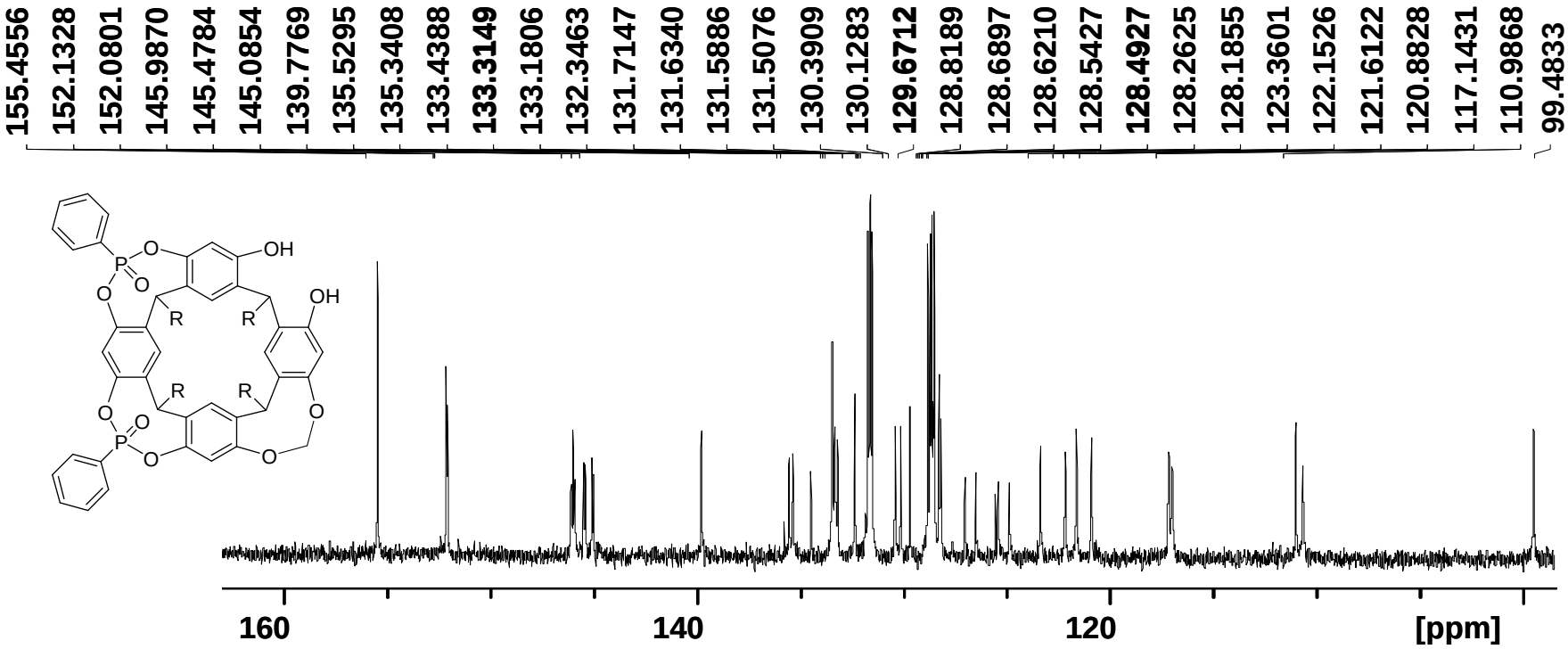
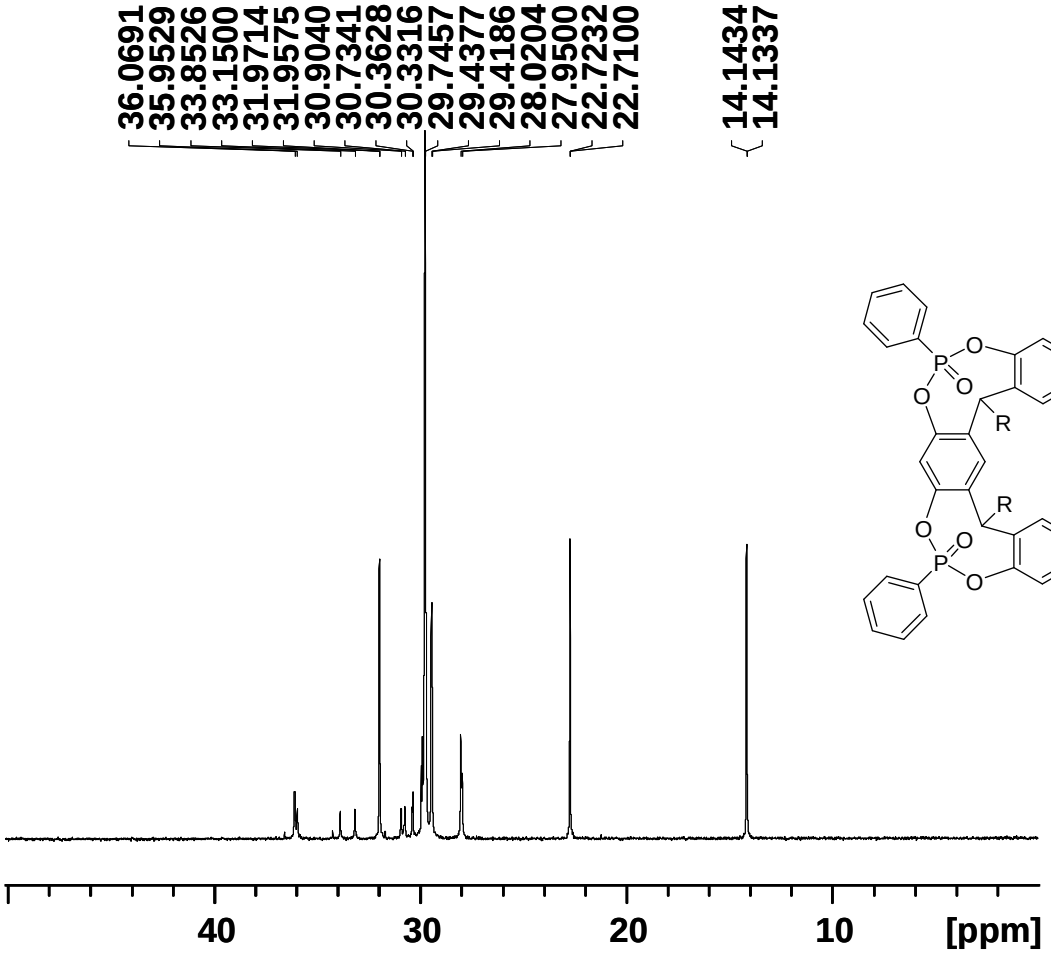


*Figure S31: ^{13}C NMR ($CDCl_3$, 125.75 MHz, 293K) of (±)-**8** (expansion)*



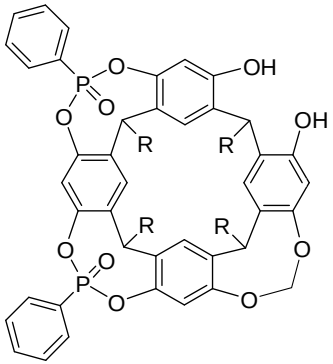


*Figure S32: ^{31}P ($CDCl_3$, 202.45 MHz, 293K) of (±)-**8***

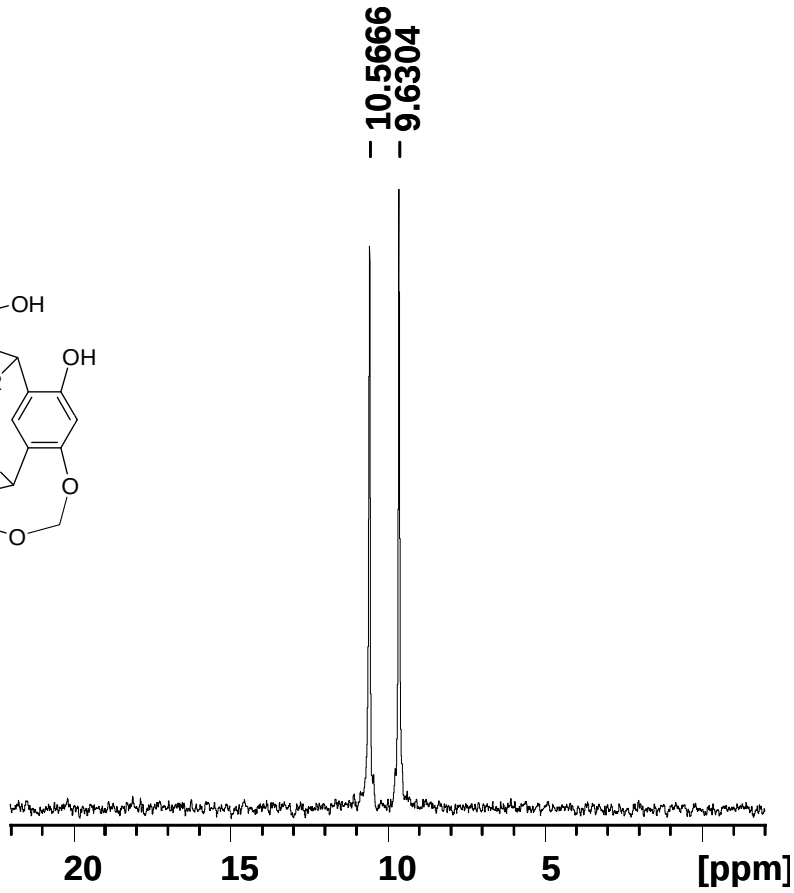


*Figure S33: jmod ($CDCl_3$, 125.75 MHz, 293K) of (±)-**8***

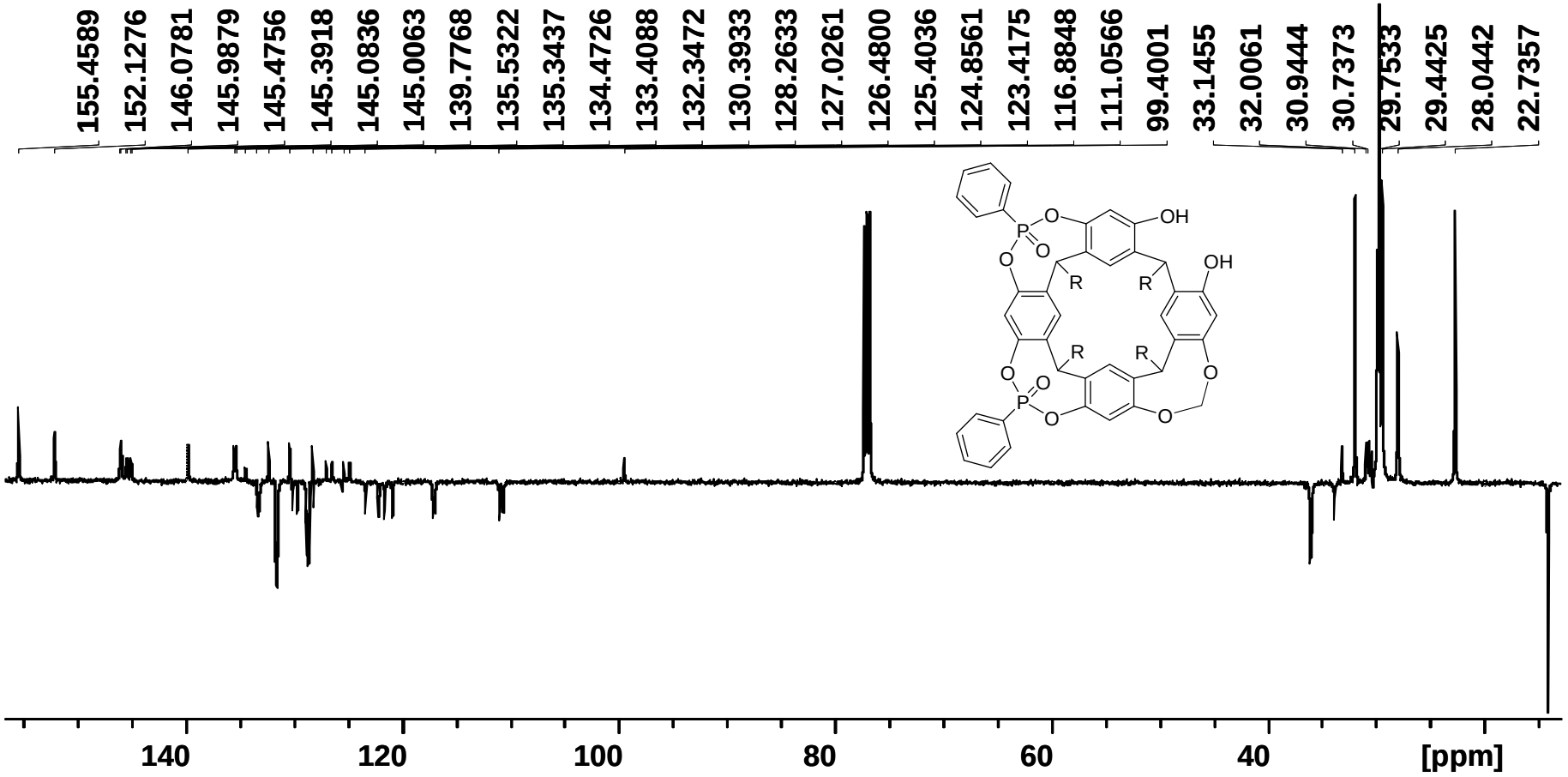
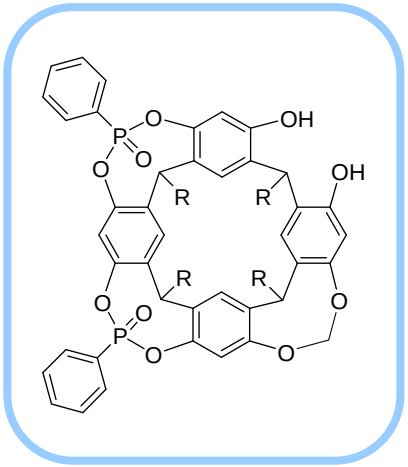
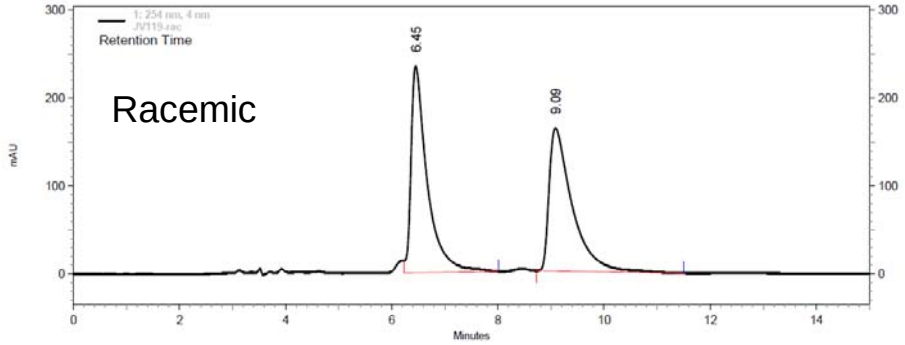
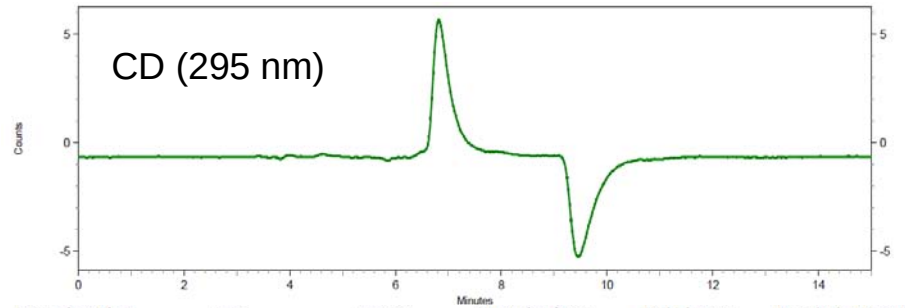


*Figure S34: Semi-Preparative HPLC Optical Resolution of (±)-**8***

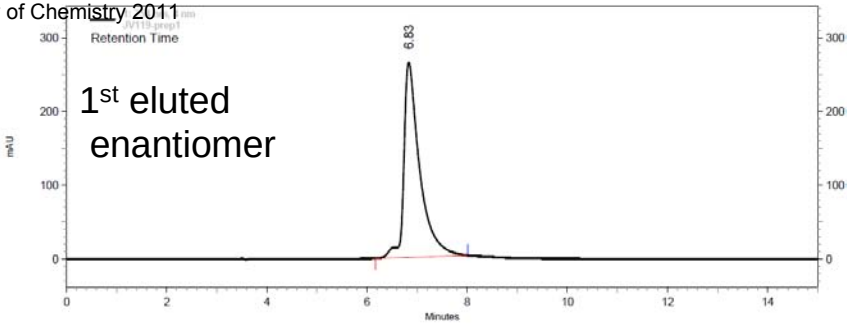


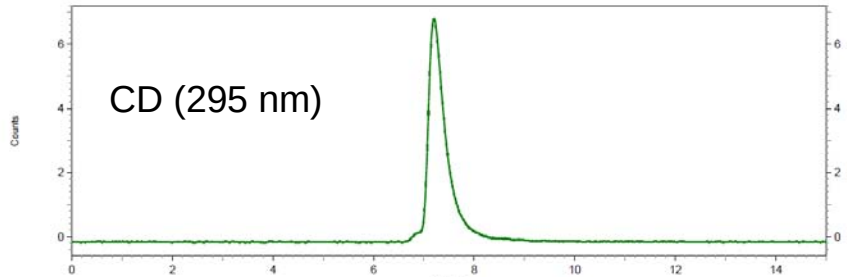
Method description : Chiralpak IA, Hexane/ethanol/chloroforme 92/4/4, 1 ml/min, DAD + CD 295nm



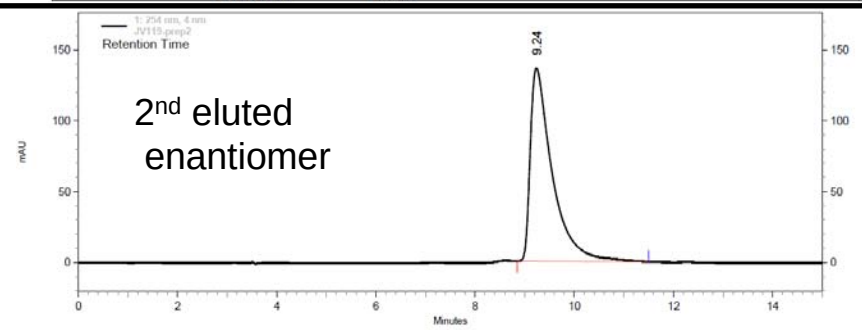


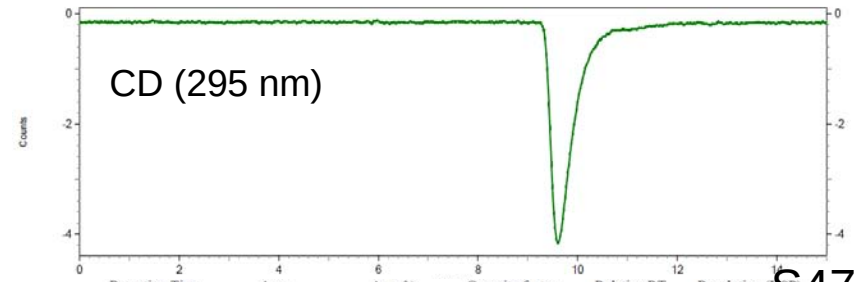
Retention Time	Area	Area %	Capacity factor	Relative RT	Resolution (USP)
6.45	19979853	50.43	1.15	1.00	0.00
9.09	19640436	49.57	2.03	1.76	4.18
Totals	39620289	100.00			





Retention Time	Area	Area %	Capacity factor	Relative RT	Resolution (USP)
6.83	23183473	100.00	1.28	0.00	0.00
Totals	23183473	100.00			





Retention Time	Area	Area %	Capacity factor	Relative RT	Resolution (USP)
9.24	16805973	100.00	2.08	0.00	0.00
Totals	16805973	100.00			

*Figure S35: ^{1}H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**11***

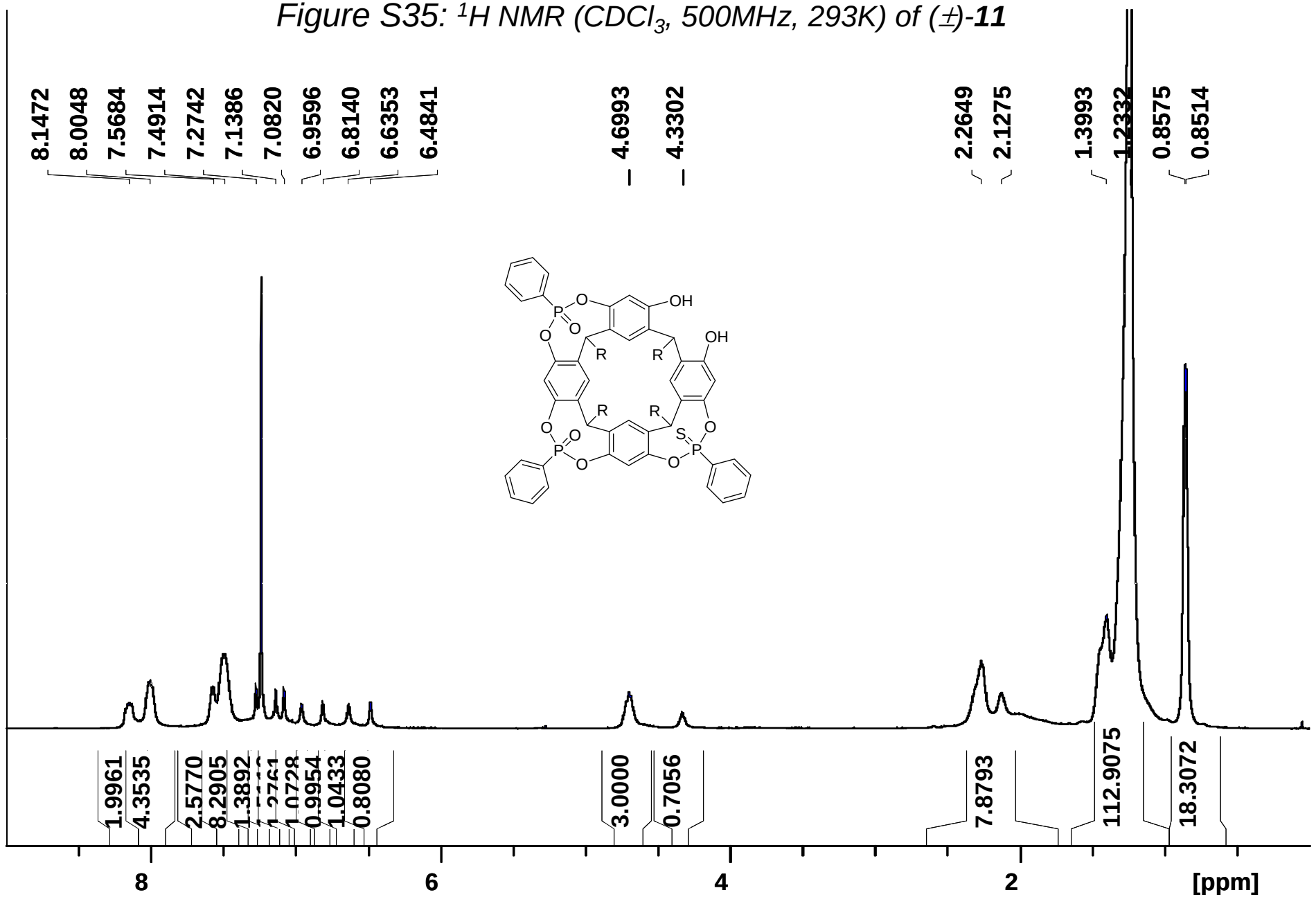


*Figure S36: HSQC ($CDCl_3$, F1: 125.75 MHz, F2 500 MHz, 293K) of (±)-**11***

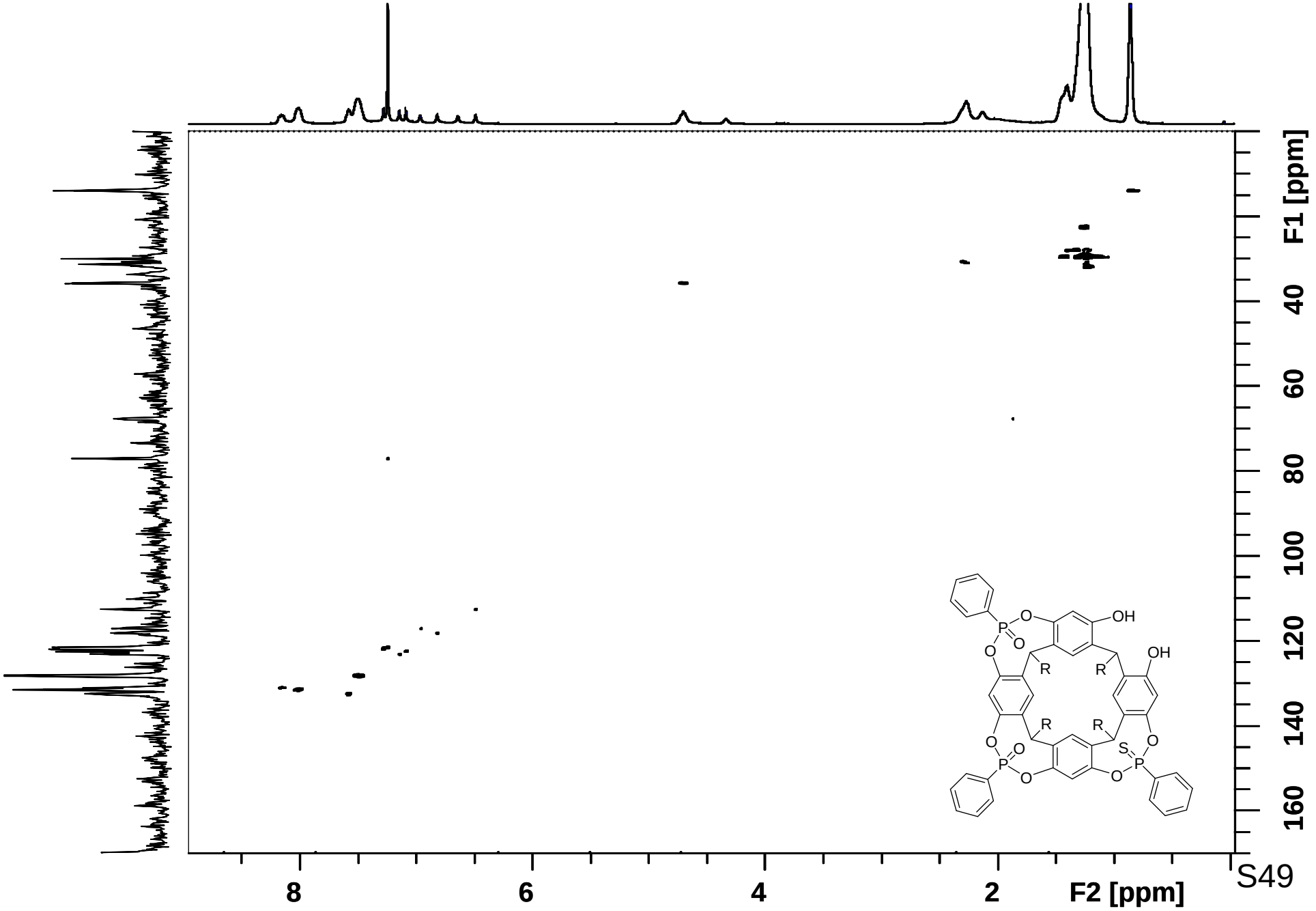


*Figure S37: HMBC ($CDCl_3$, F1: 125.75 MHz, F2 500 MHz, 293K) of (±)-**11***

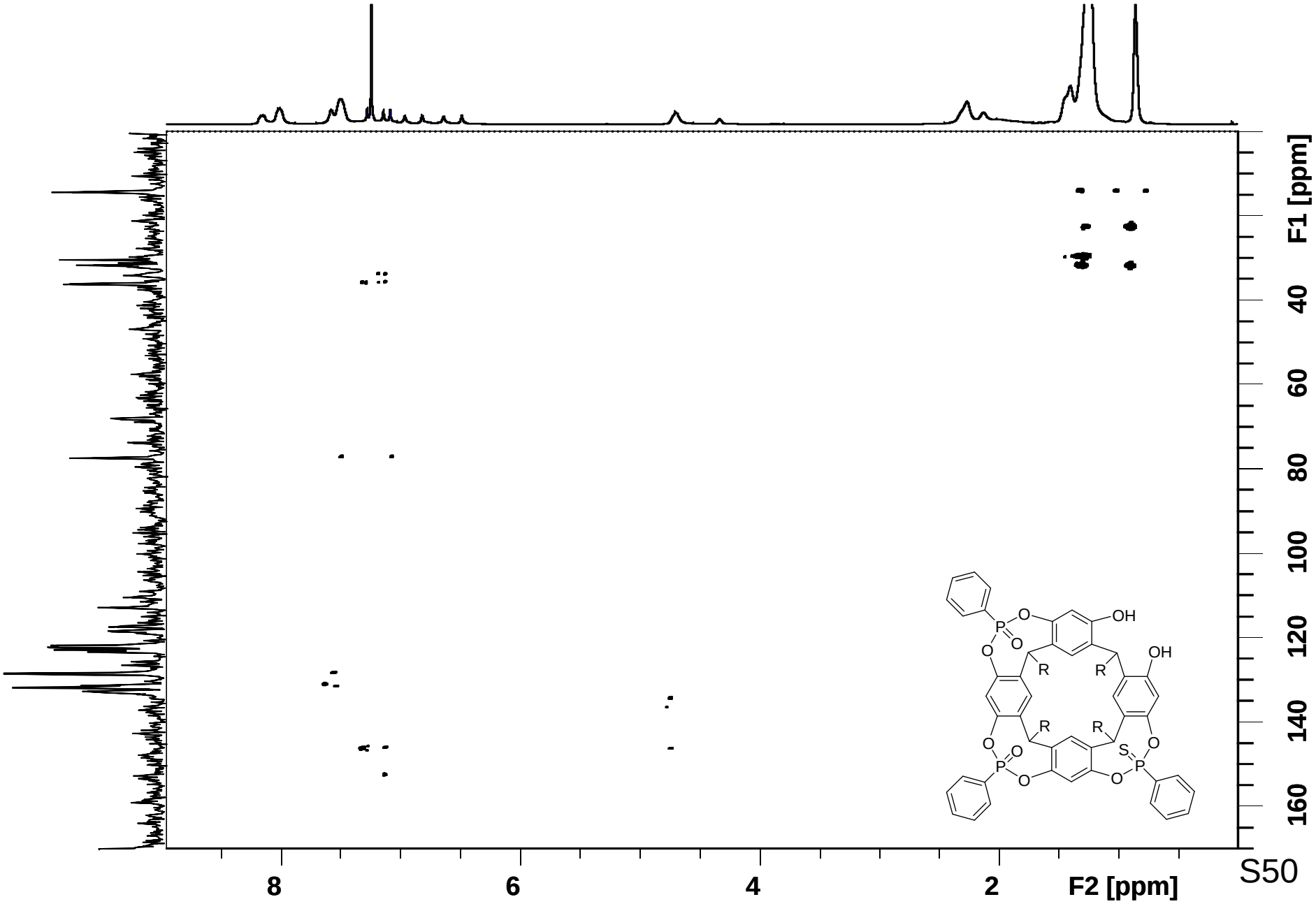


*Figure S38: ^{31}P ($CDCl_3$, 81.01 MHz, 293K) of (±)-**11***

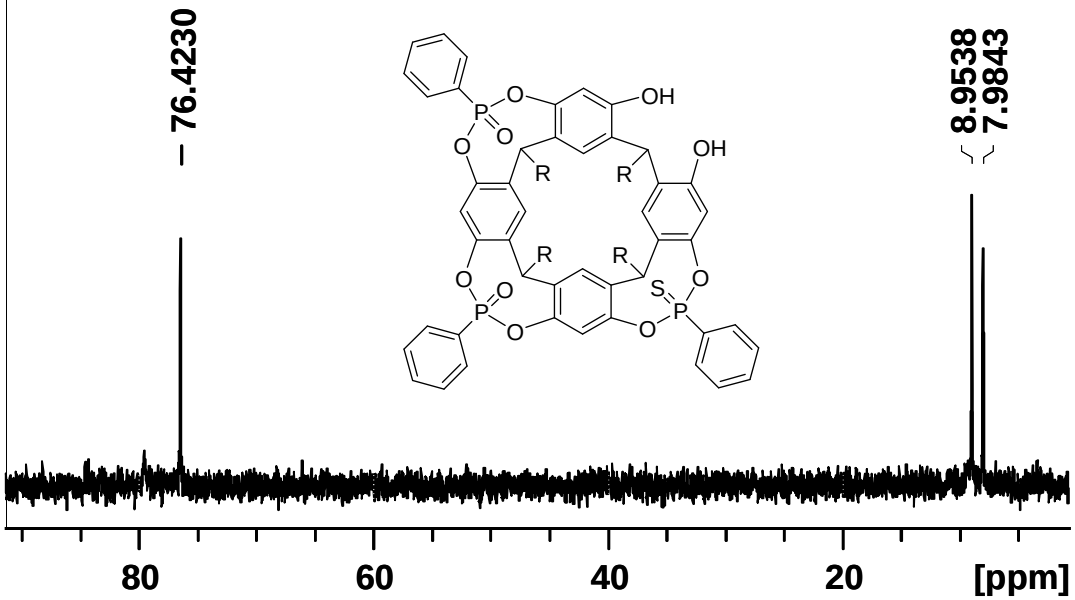


*Figure S39: ^{1}H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**12***

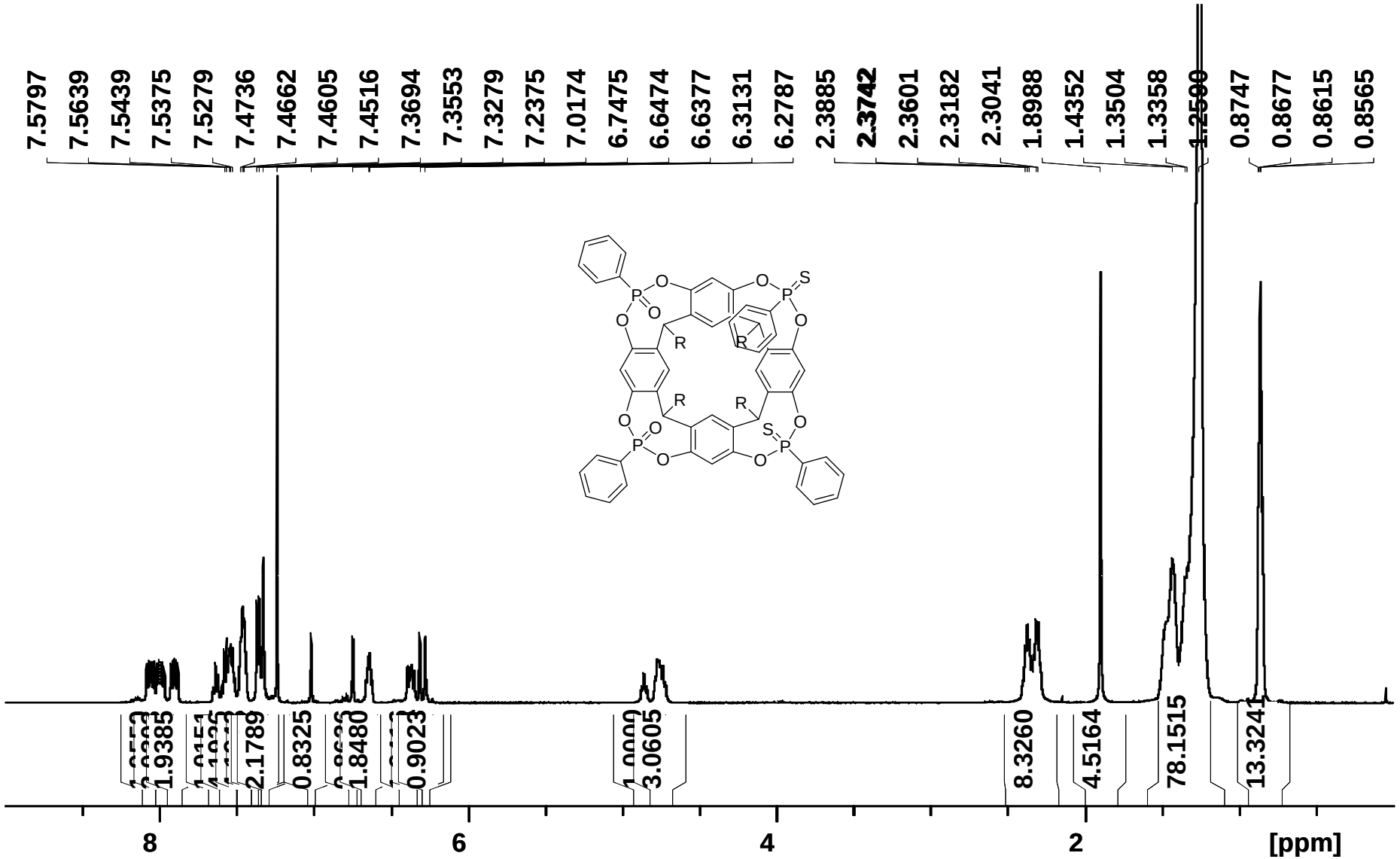


*Figure S40: ^1H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**12** (expansion)*

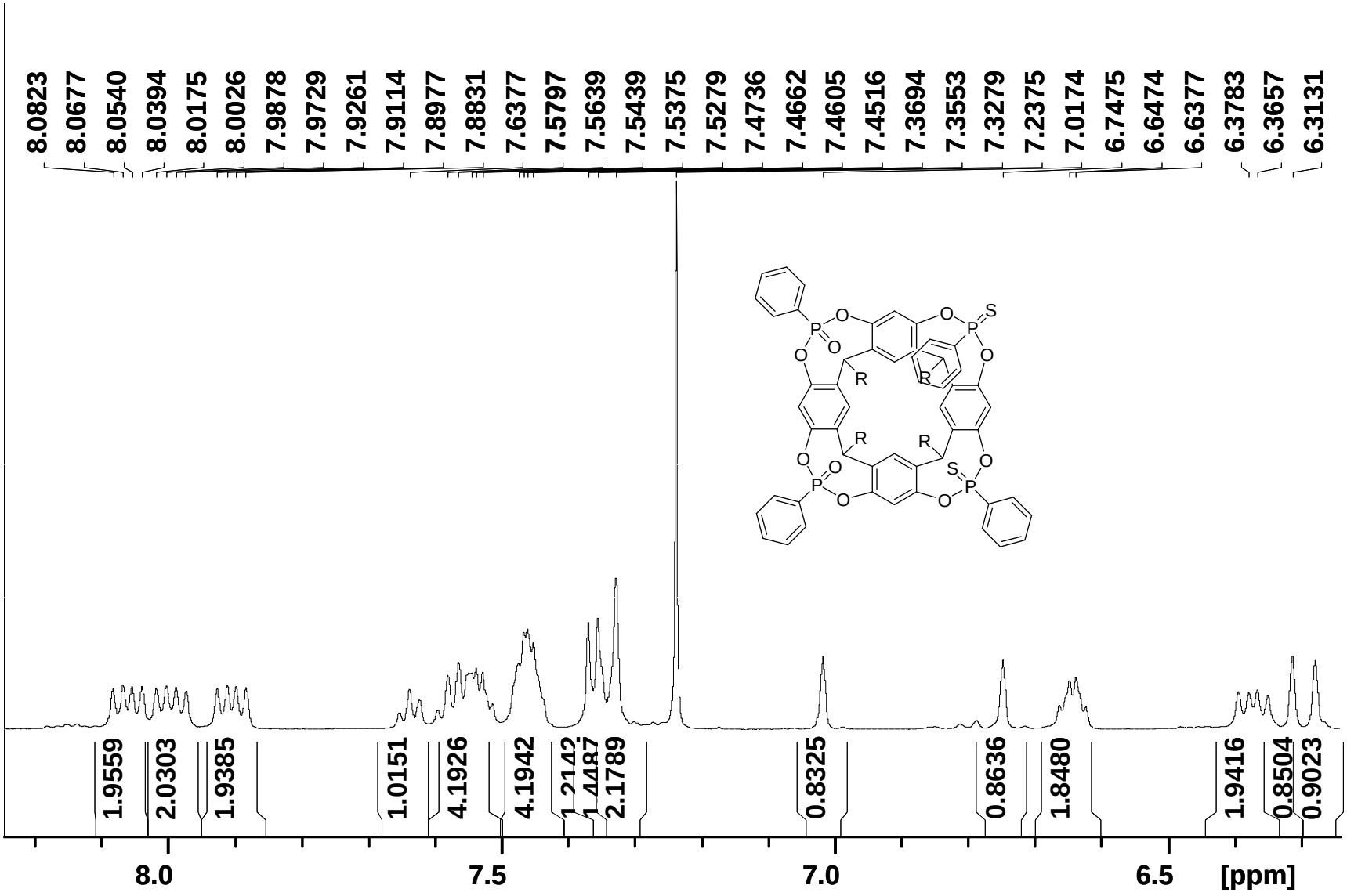


*Figure S41: jmod ($CDCl_3$, 125.75 MHz, 293K) of (±)-**12***

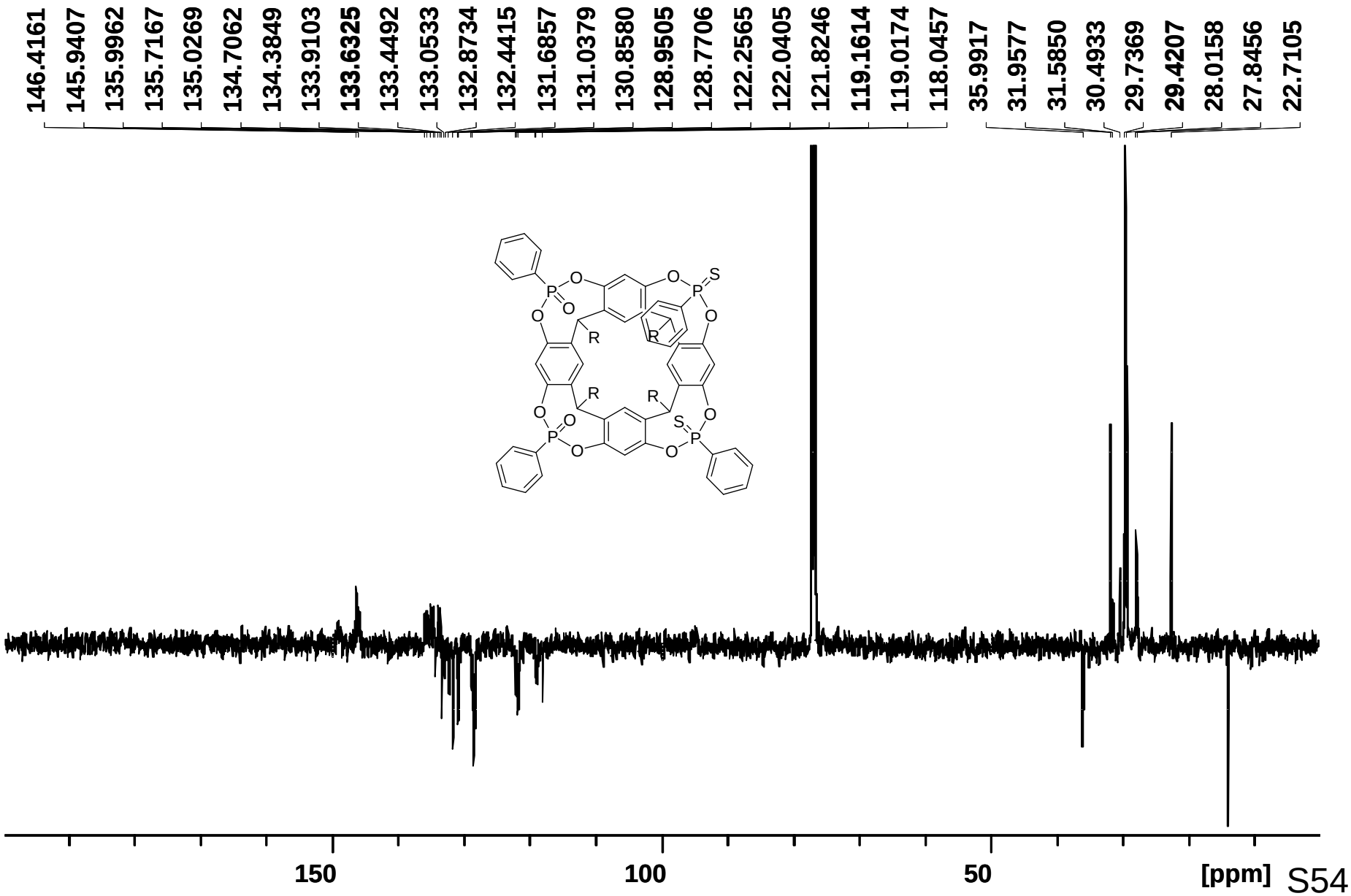


*Figure S42: ^{31}P ($CDCl_3$, 202.45 MHz, 293K) of (±)-**12***

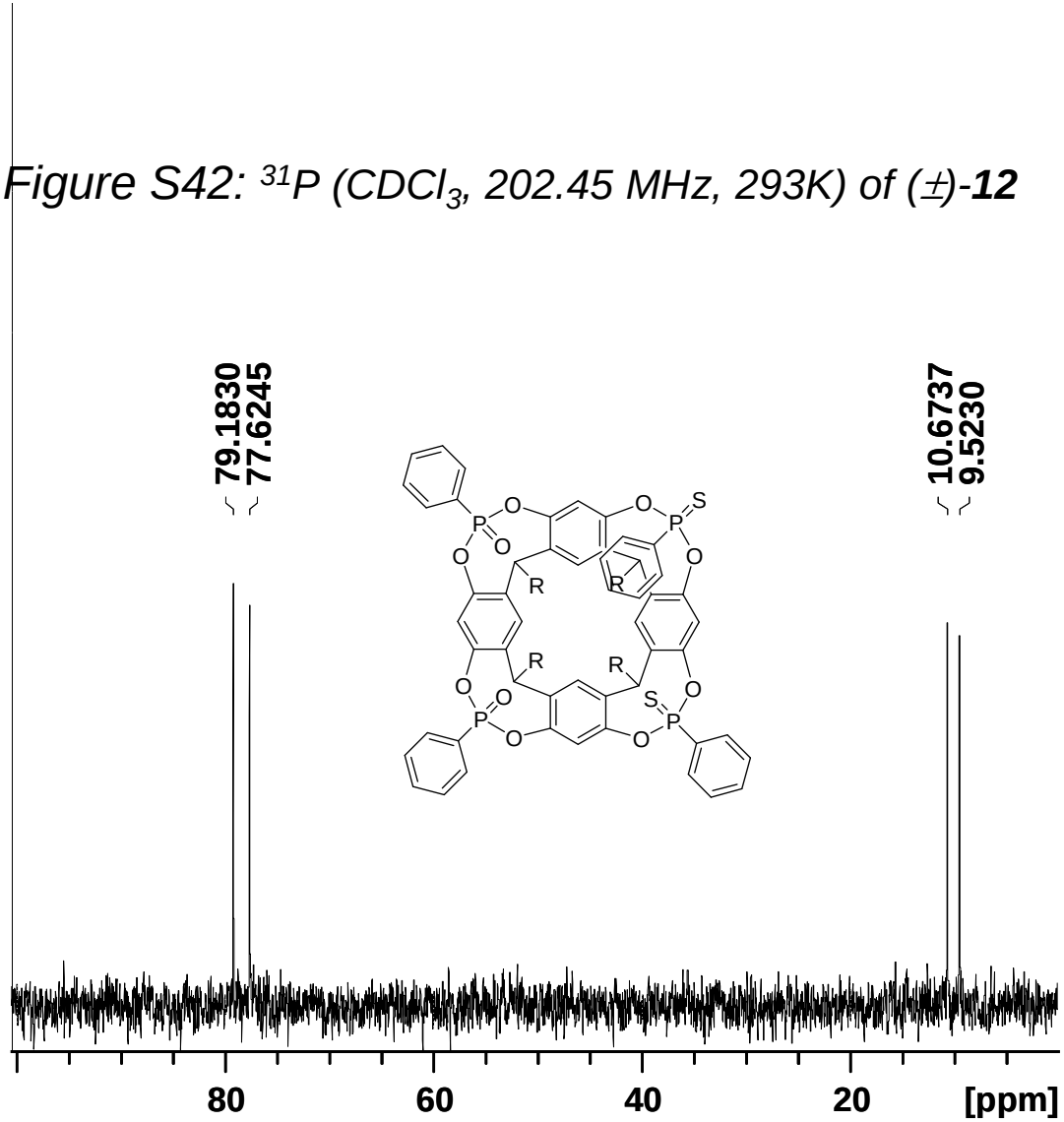


*Figure S43: ^1H NMR ($CDCl_3$, 500MHz, 293K) of **13***

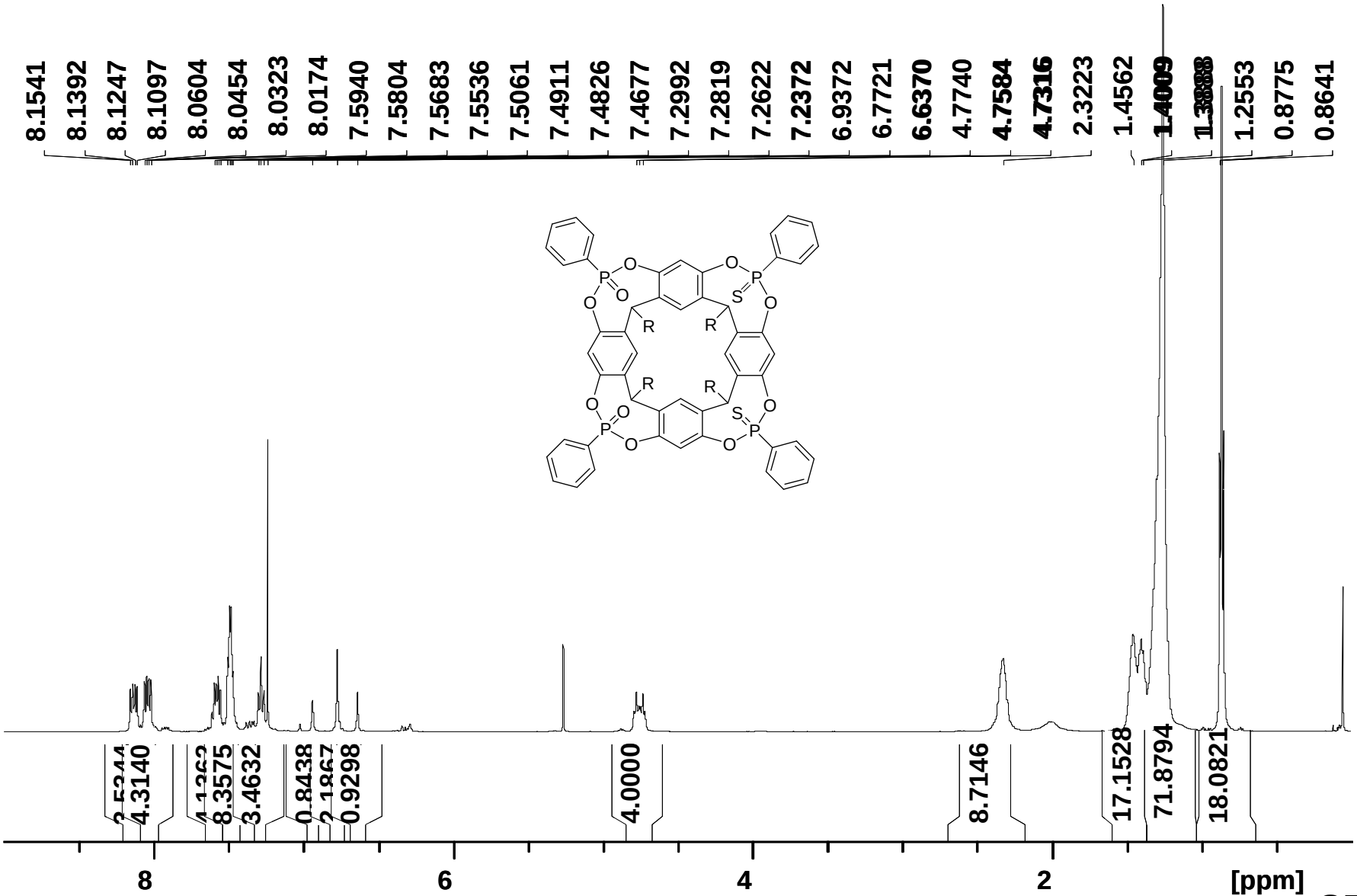


*Figure S44: ^{13}C NMR ($CDCl_3$, 125.75 MHz, 293K) of **13***

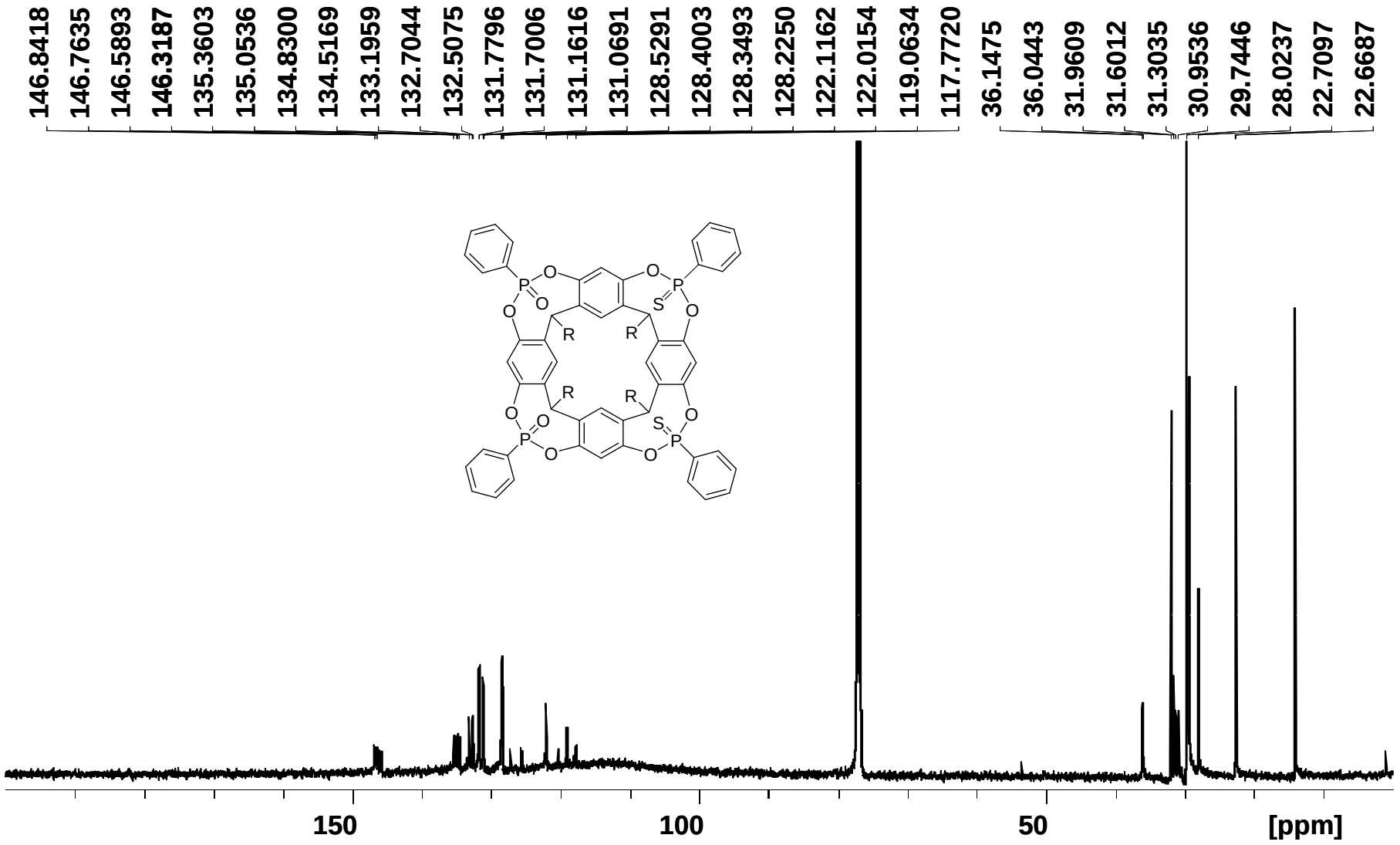


Figure S45: jmod ($CDCl_3$, 125.75 MHz, 293K) of ***13***

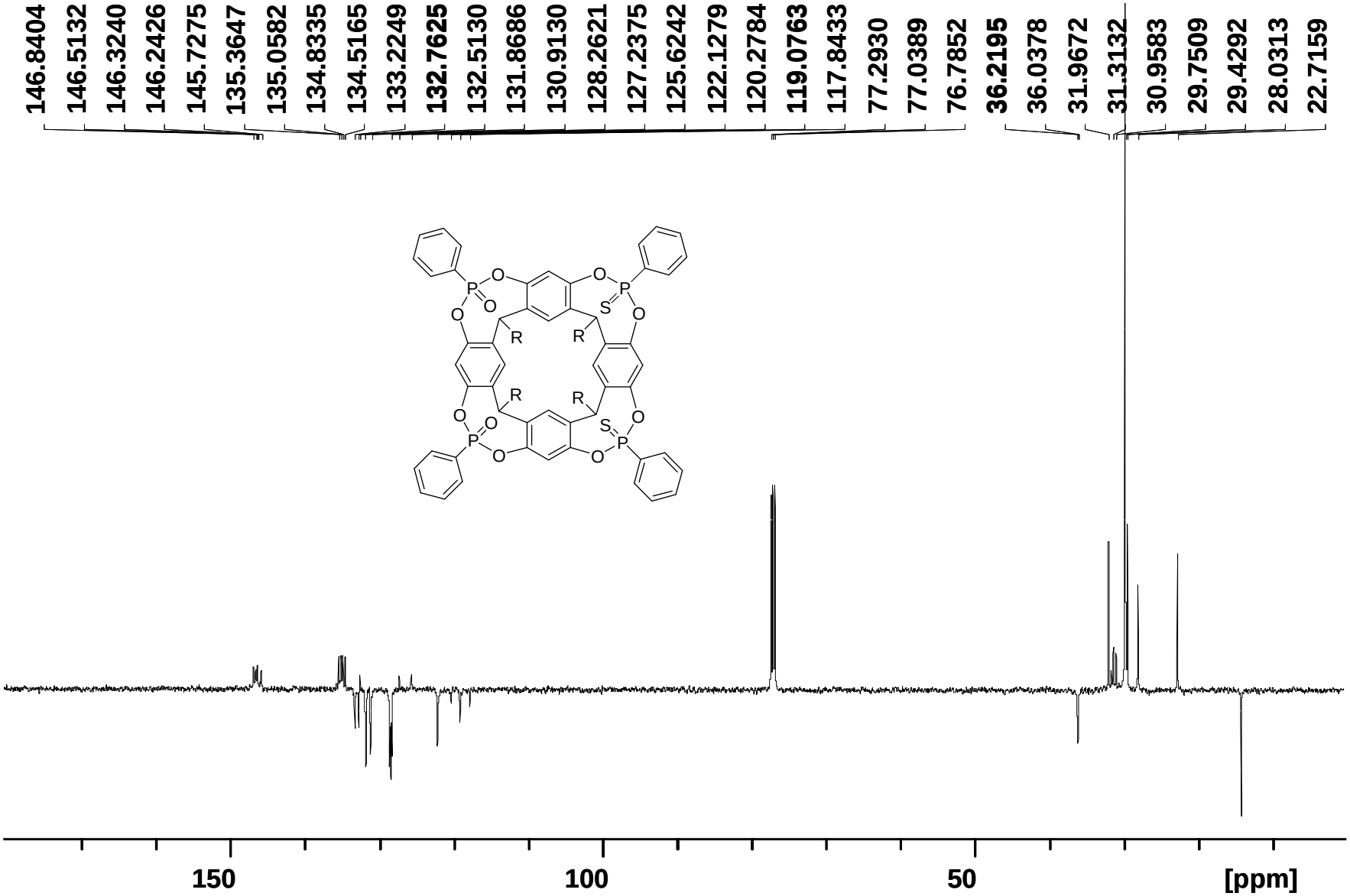


*Figure S46: ^{31}P ($CDCl_3$, 81.01 MHz, 293K) of **13***

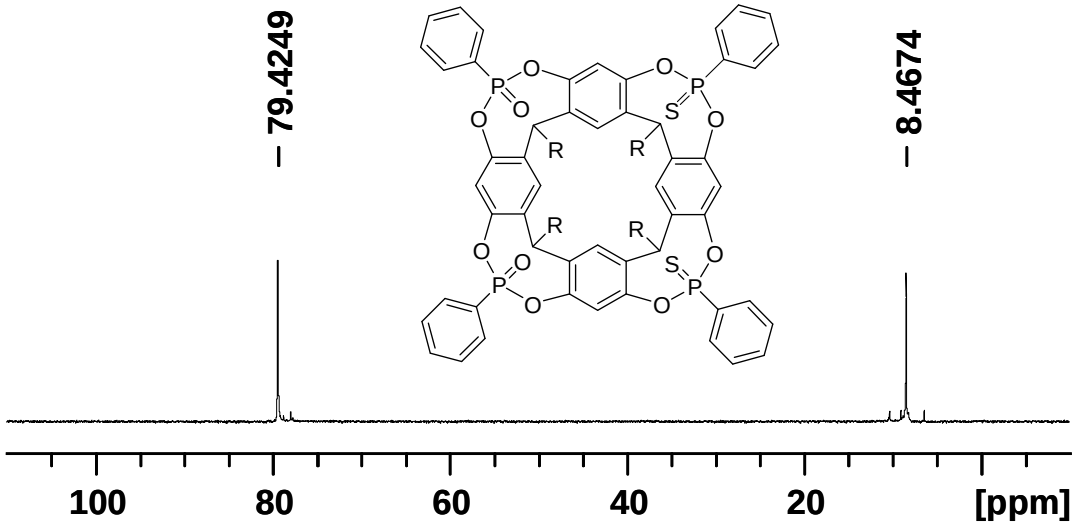


*Figure S47: ^1H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**15***

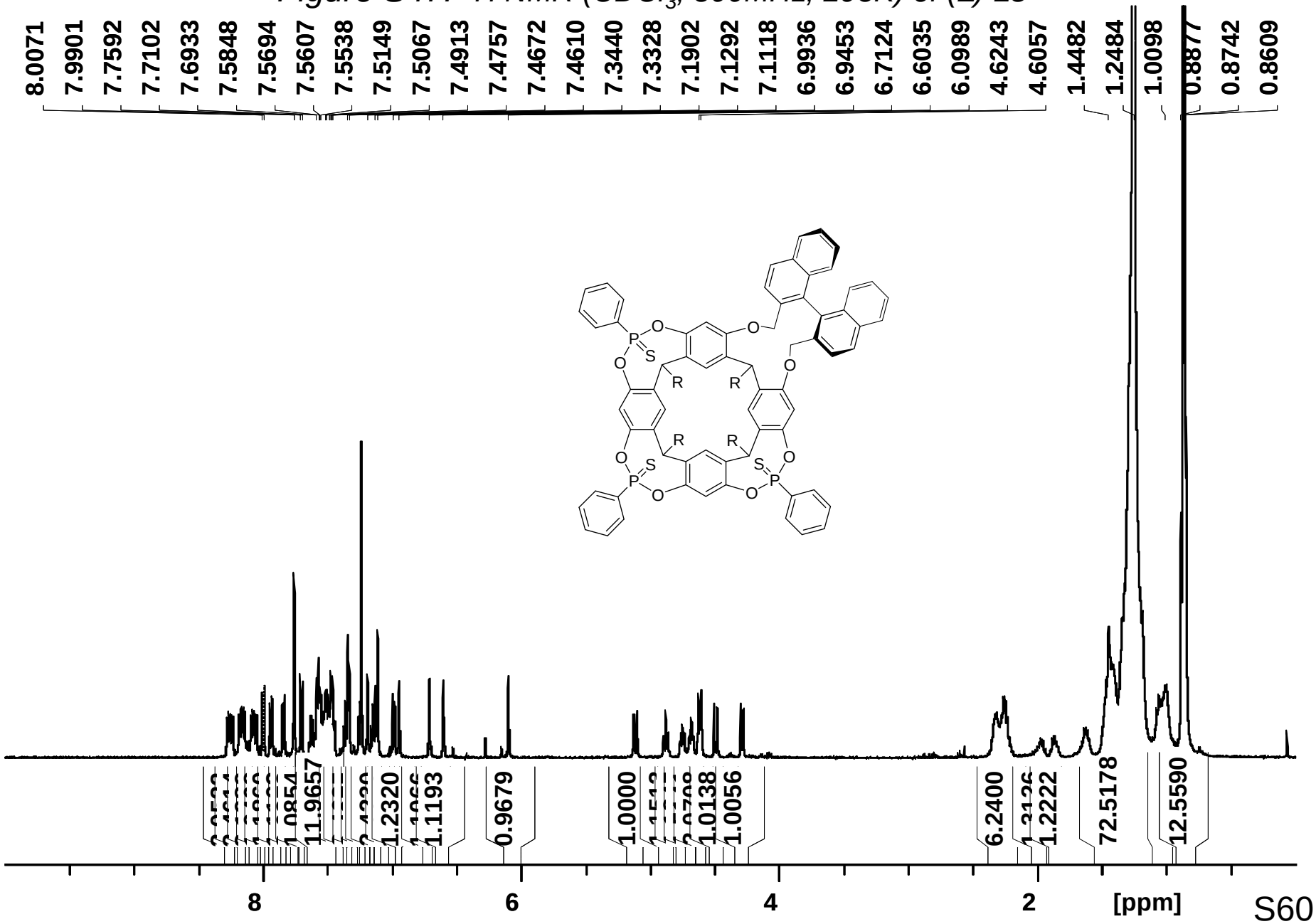


*Figure S48: ^{13}C ($CDCl_3$, 125.75 MHz, 293K) of (±)-**15***

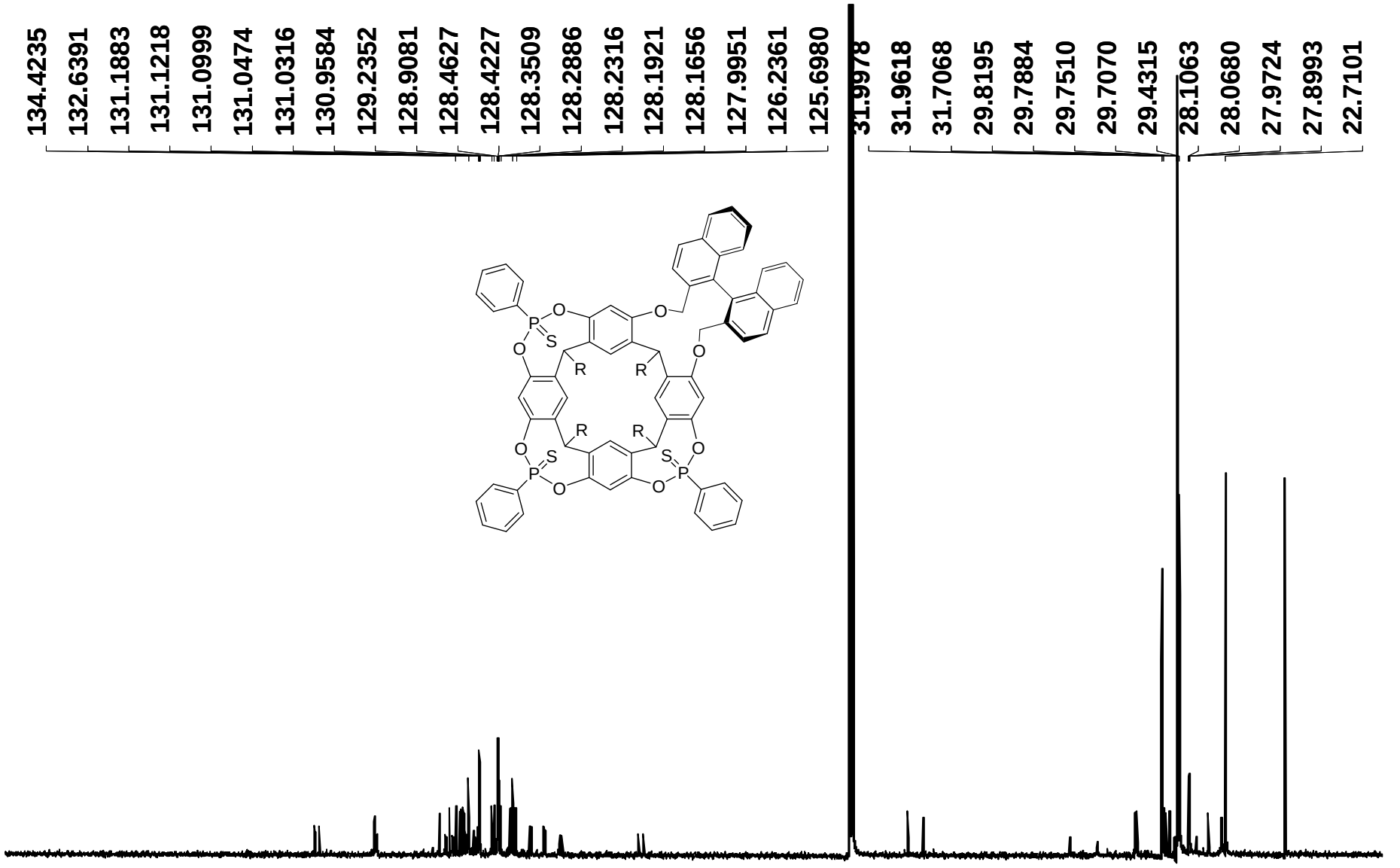


*Figure S49: ^{31}P ($CDCl_3$, 202.45 MHz, 293K) of (±)-**15***

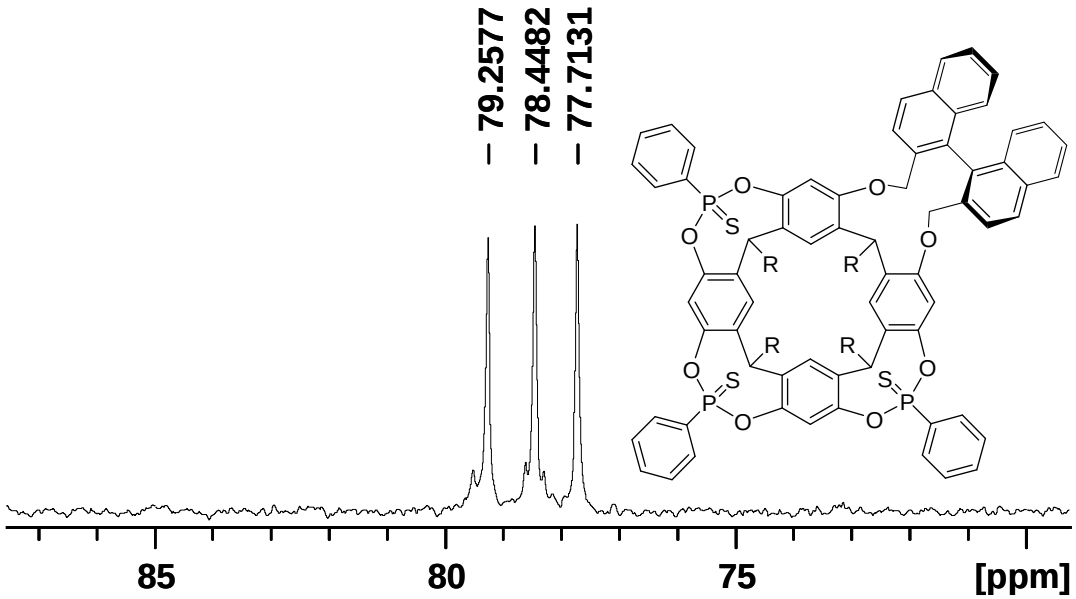


*Figure S50: ^1H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**16***

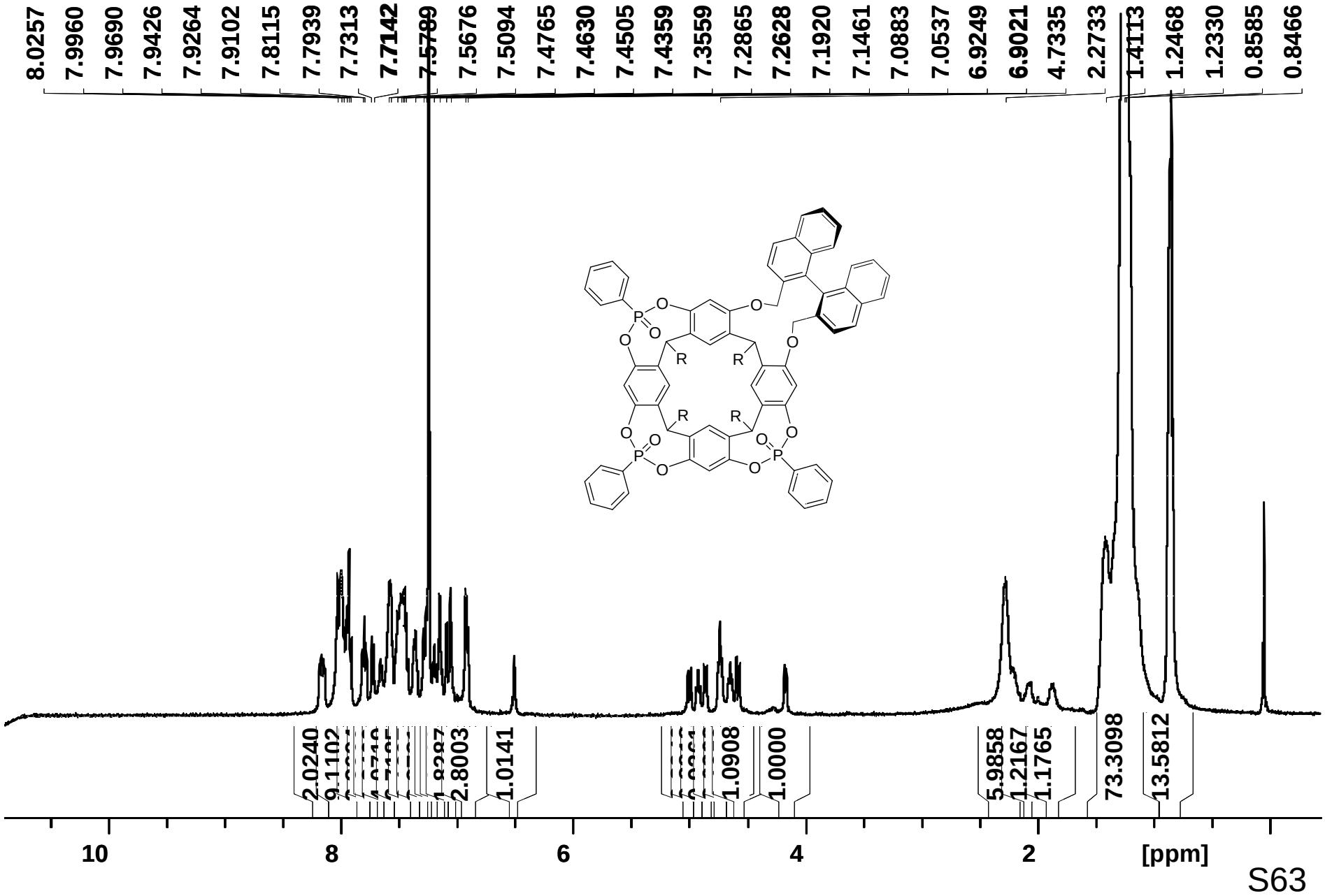


*Figure S51: ^{1}H NMR ($CDCl_3$, 500MHz, 293K) of (±)-**16** (expansion)*

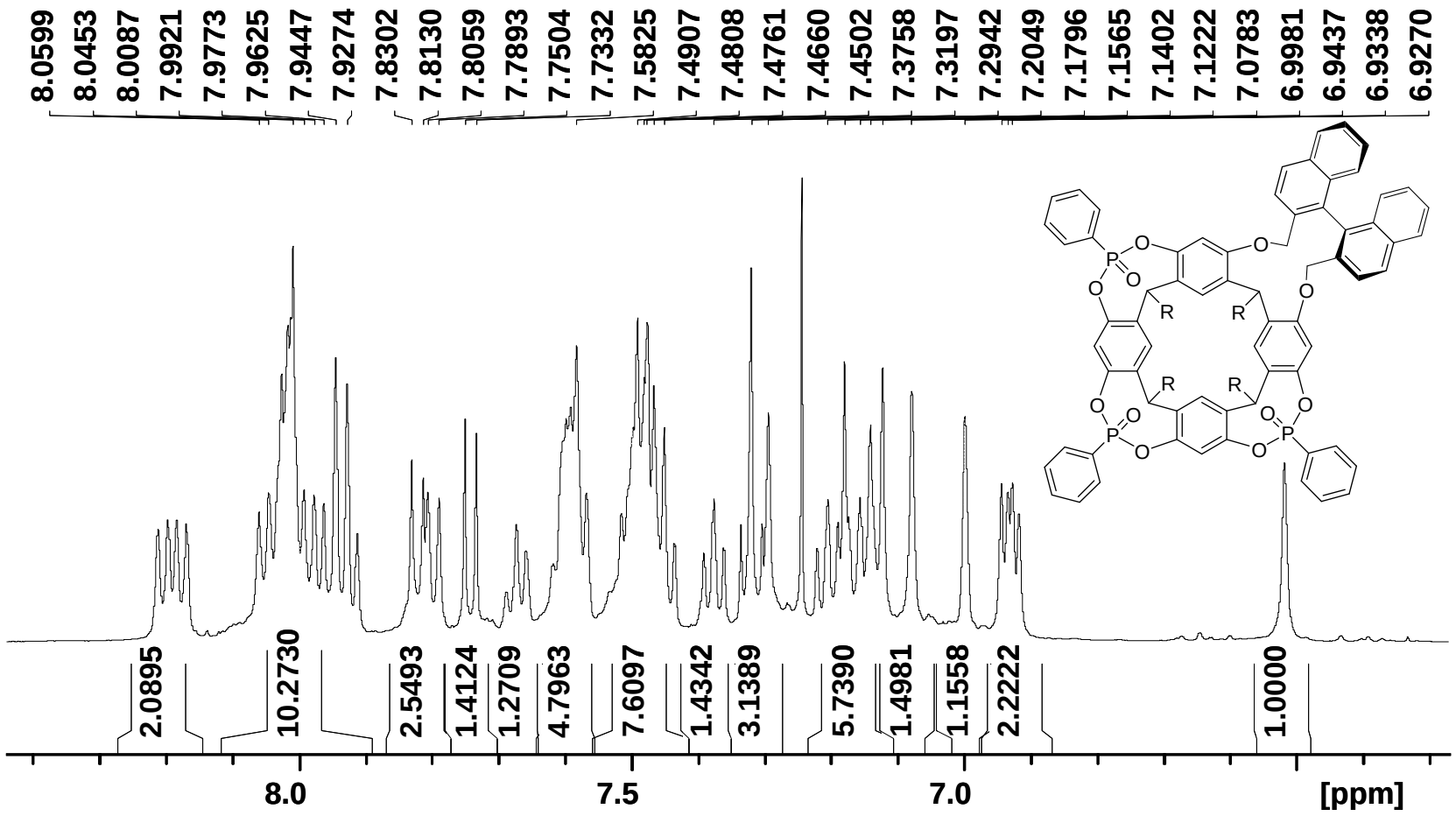


*Figure S52: ^{13}C ($CDCl_3$, 125.75 MHz, 293K) of (±)-**16***

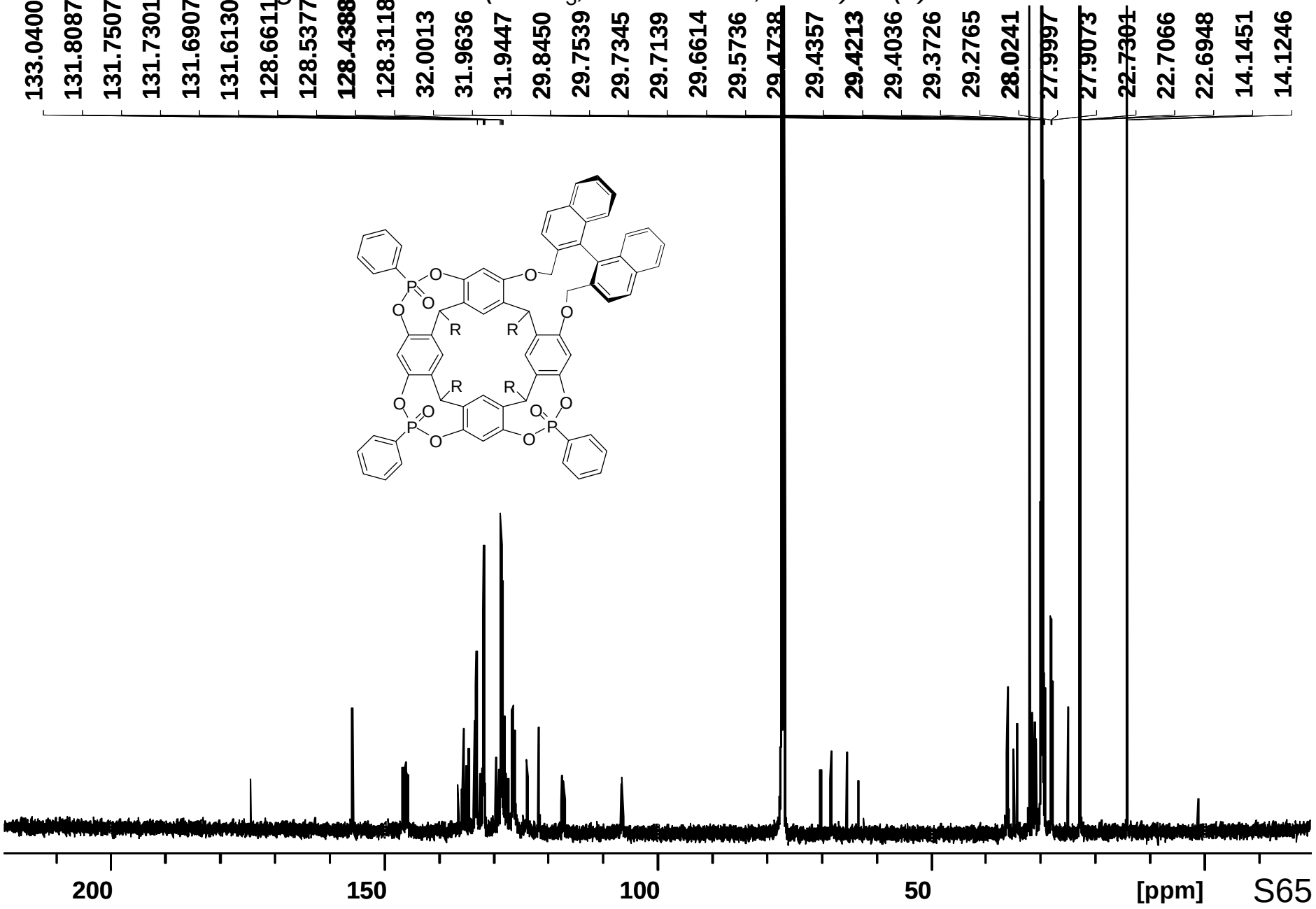


*Figure S53: ^{31}P ($CDCl_3$, 202.45 MHz, 293K) of (±)-**16***

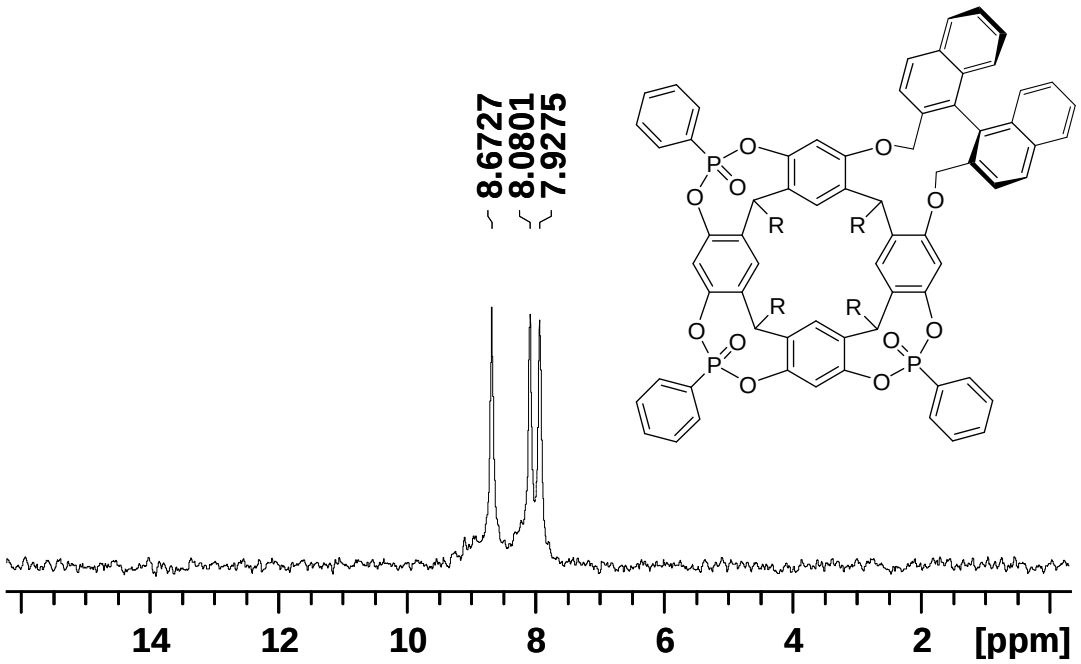
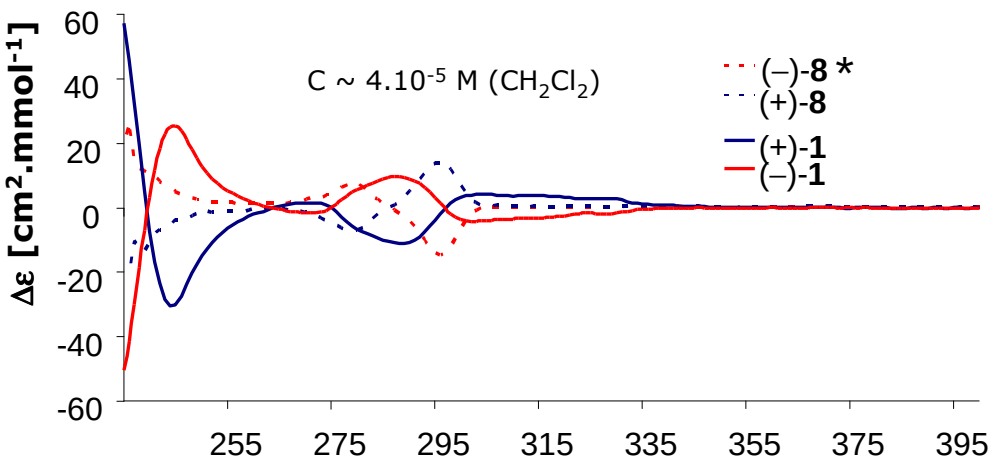
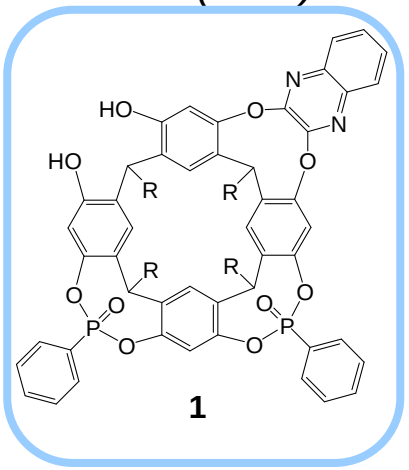
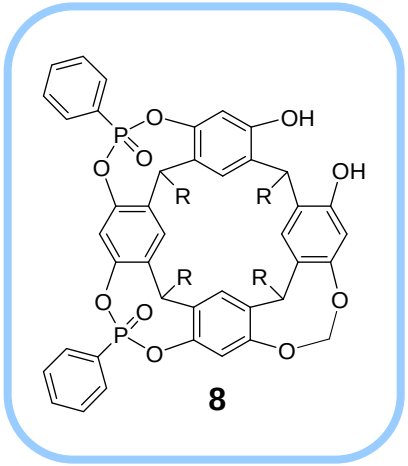


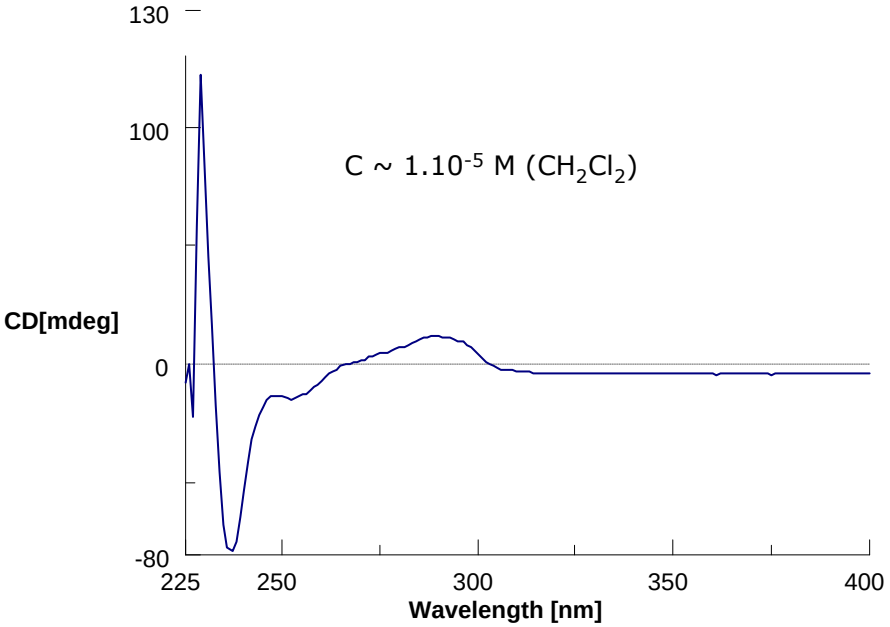
Figure S54: Electronic Circular Dichroism (ECD)

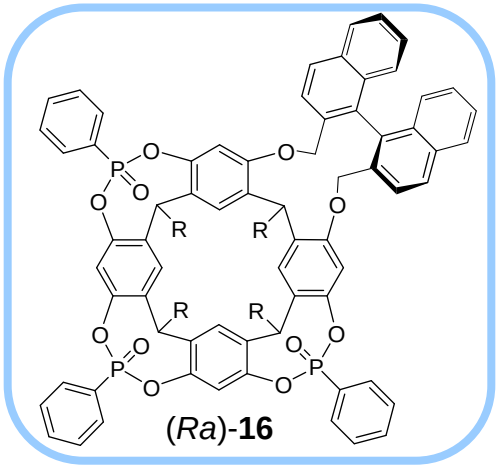






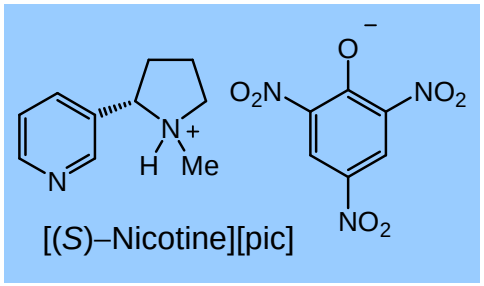
* As compound **8** display no optical rotation at all the wavelenghts tested, signs of (+) and (**-**)-**8** refers to the CD sign at 295 nm measured by the CD detector directly on the HPLC.

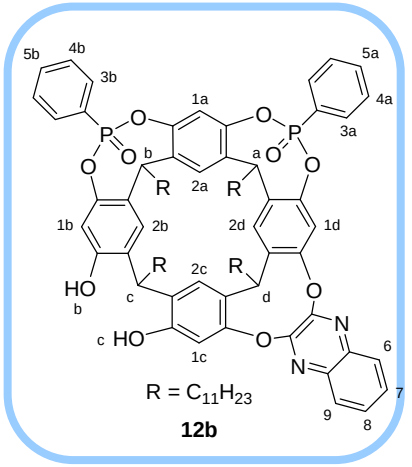




α_d^{20} = 112°(c ~ 0,1 acetone)

*Figure S55:Complex (S)-Nicotine@(±)-**1***





■ *^{1}H NMR ($CDCl_3$, 500MHz, 293K)*

■ *^{31}P NMR ($CDCl_3$, 500MHz, 293K)*

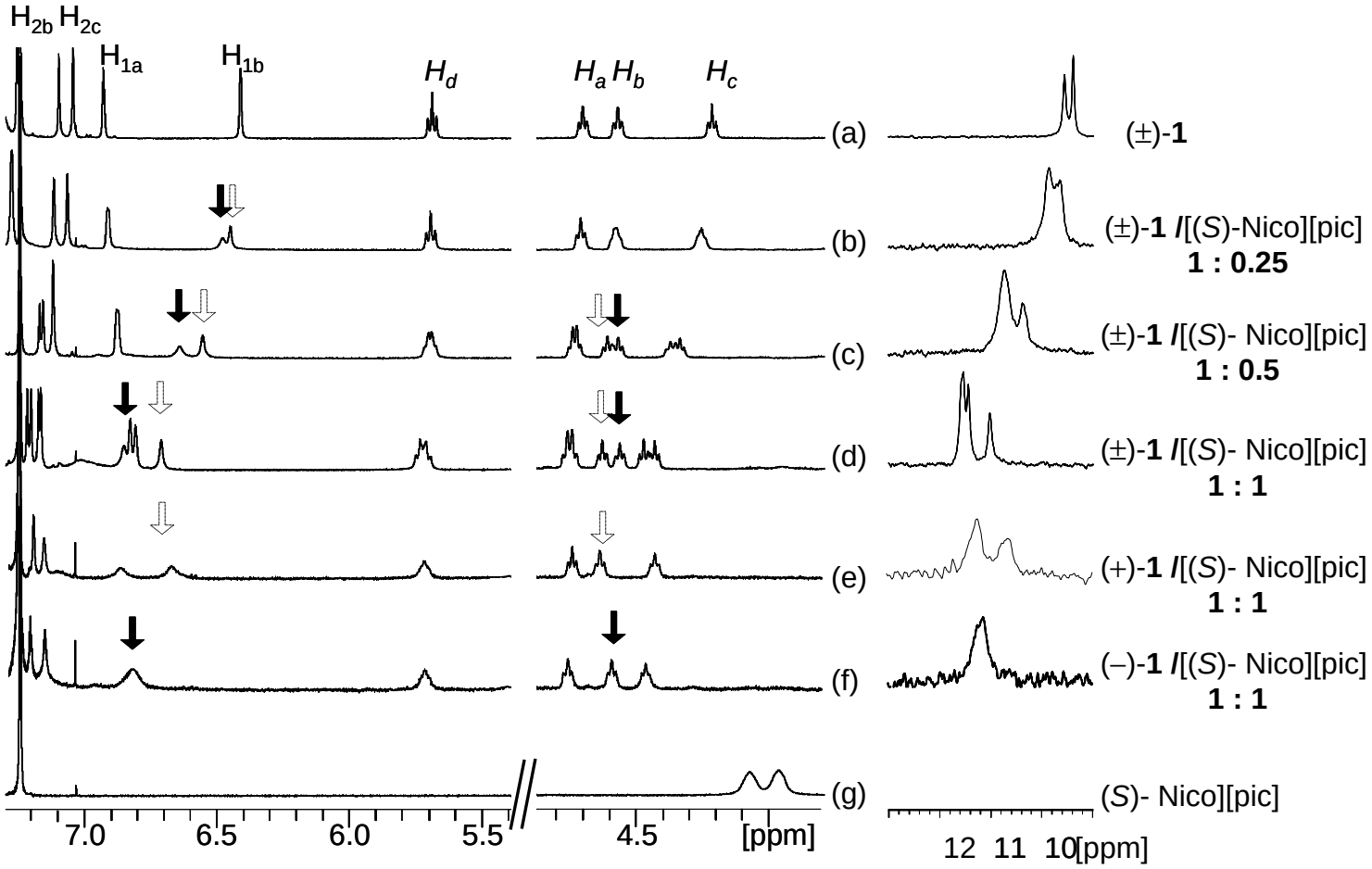


*Figure S56: Complex Adrenaline@(±)-**1***

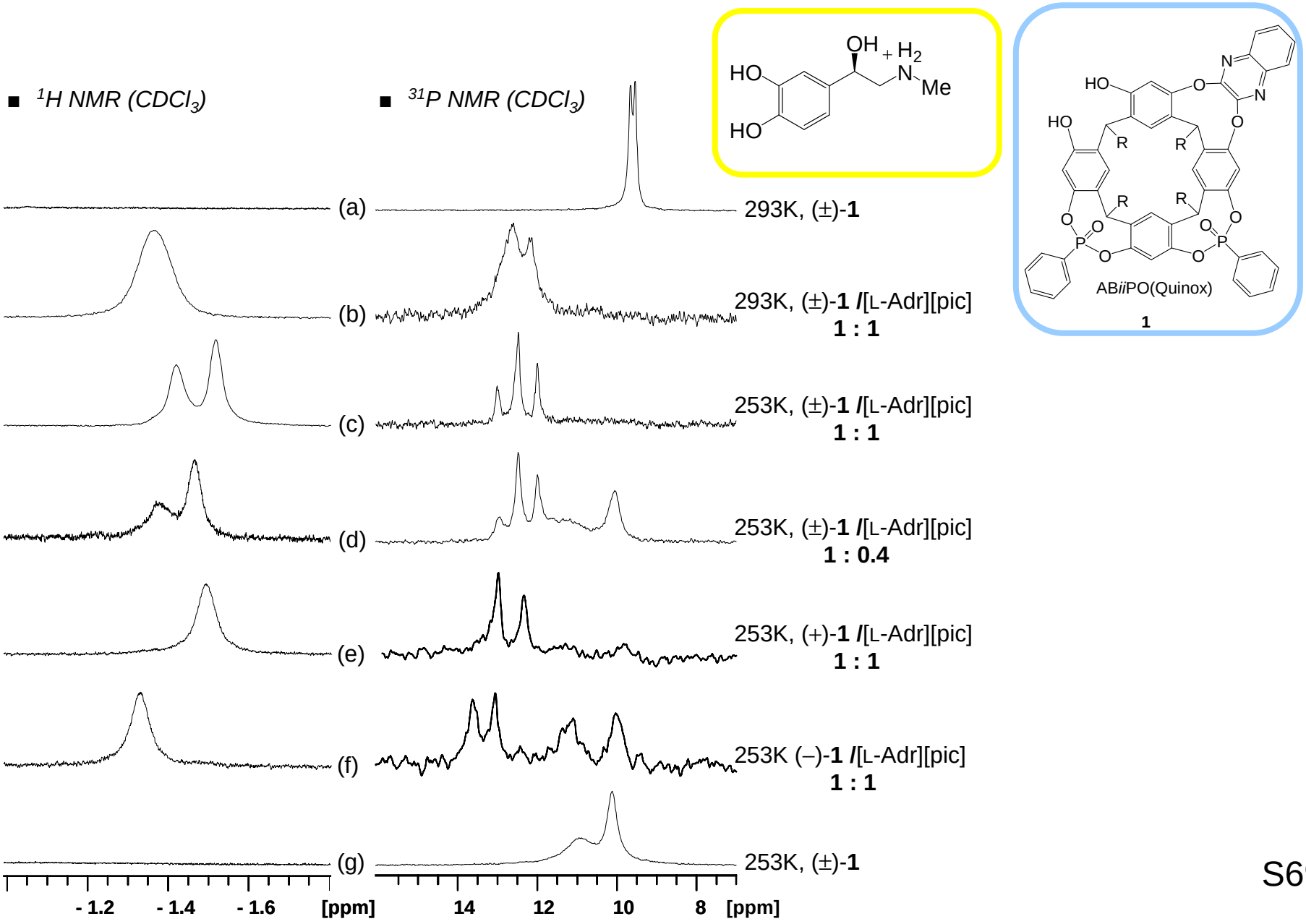


*Figure S57: Complex Ephedrine@(±)-**1***

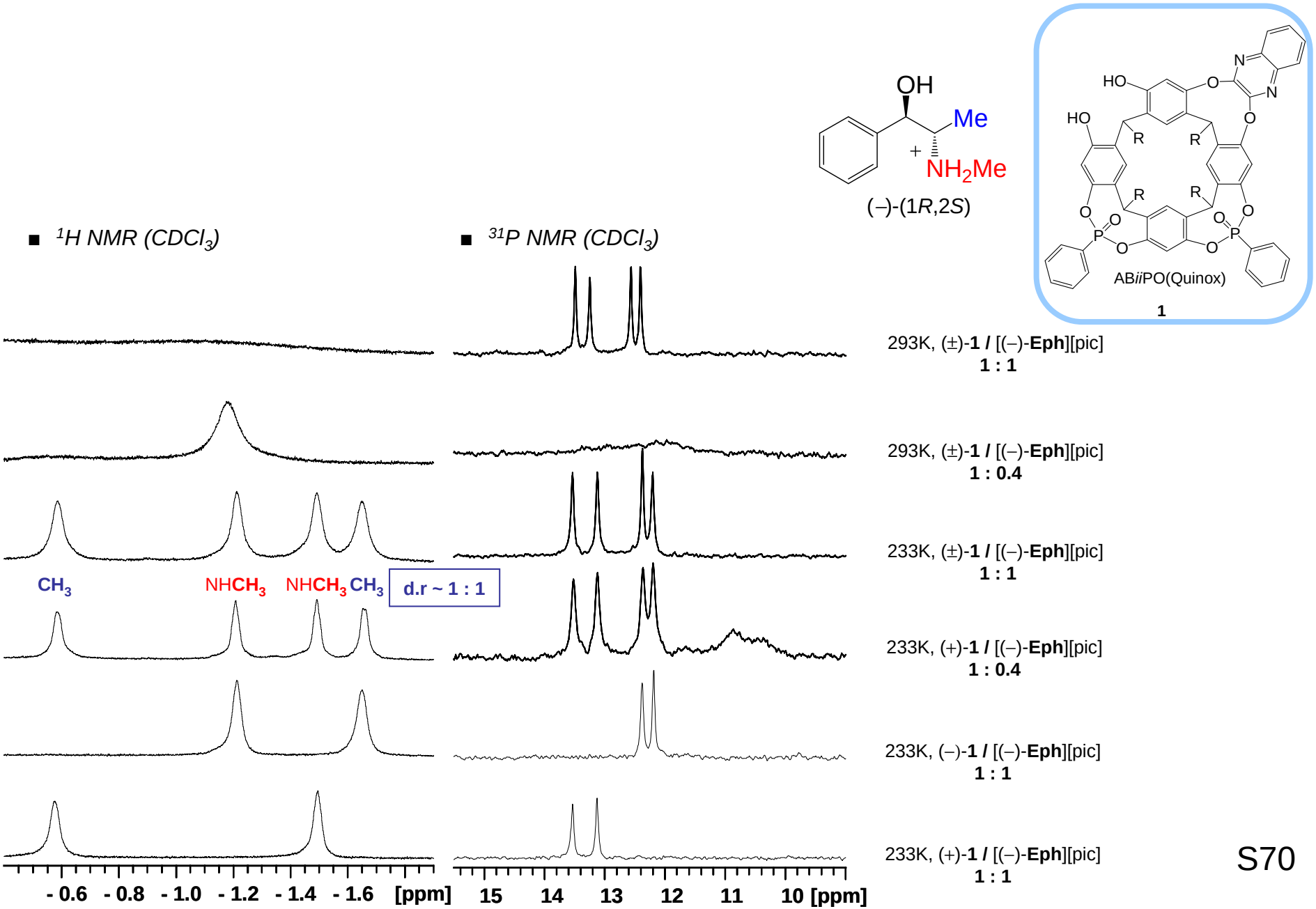


*Figure S58: Complex Pseudoephedrine@(±)-**1***

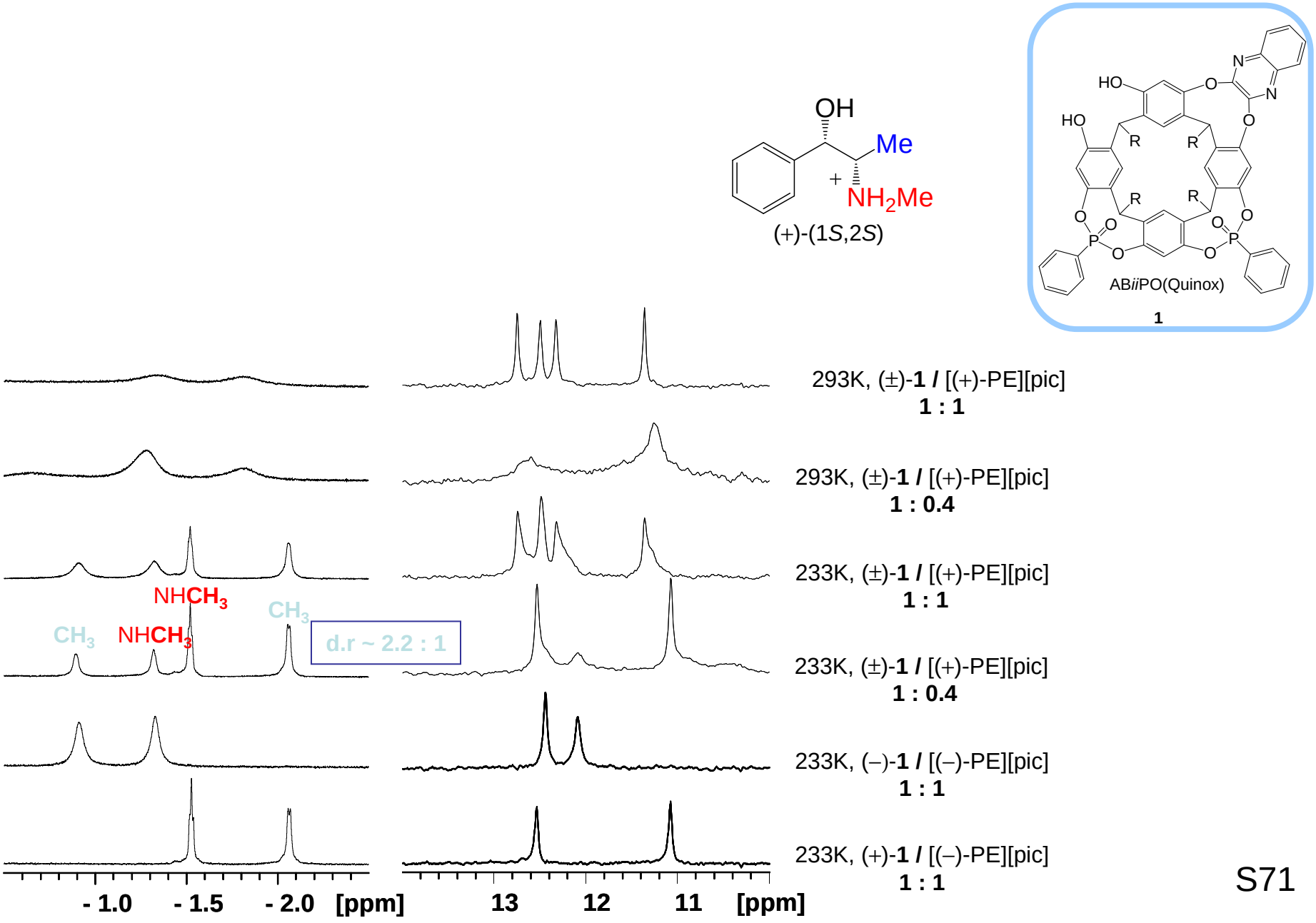
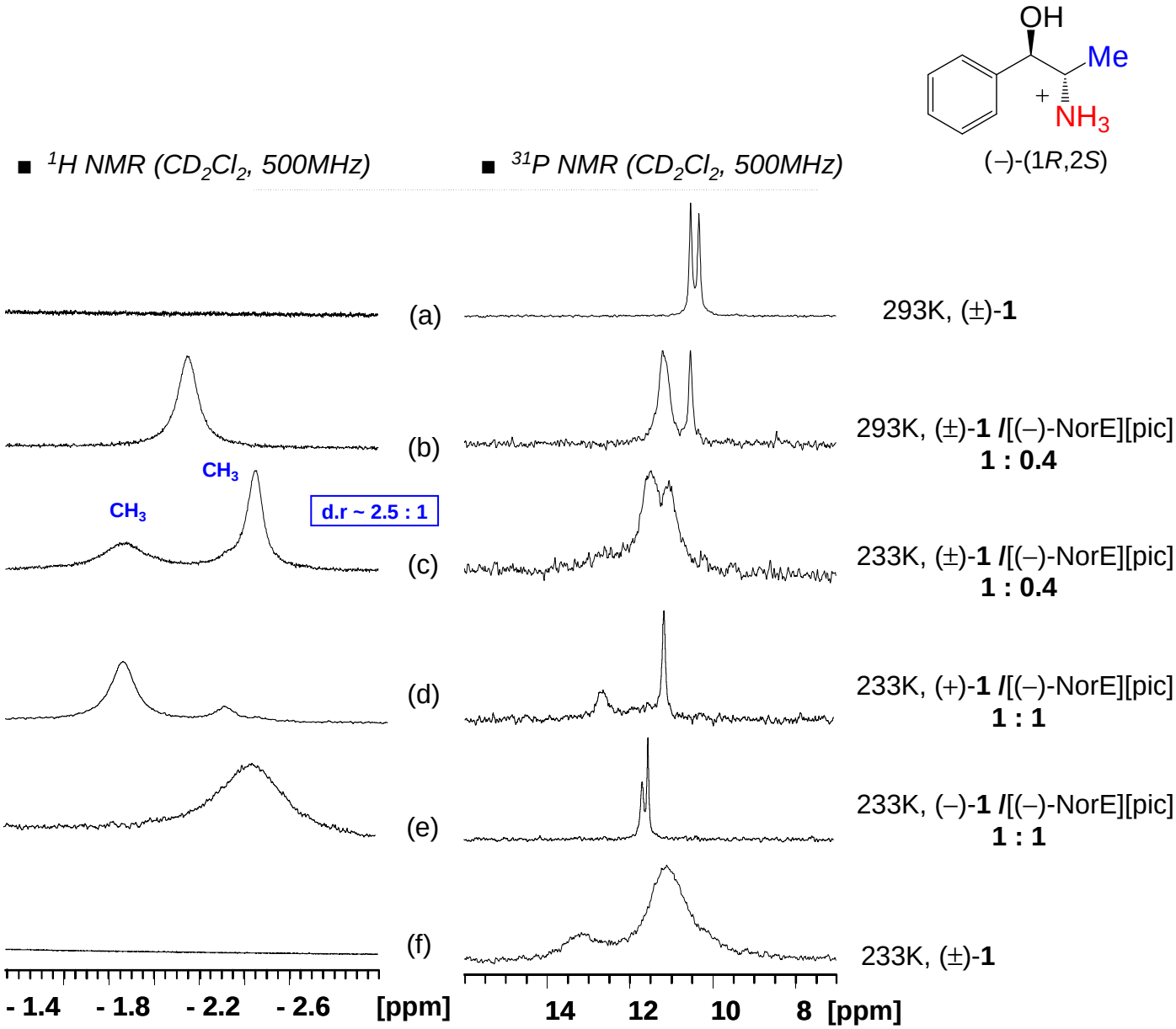


*Figure S59: Complex Norephedrine@(±)-**1***



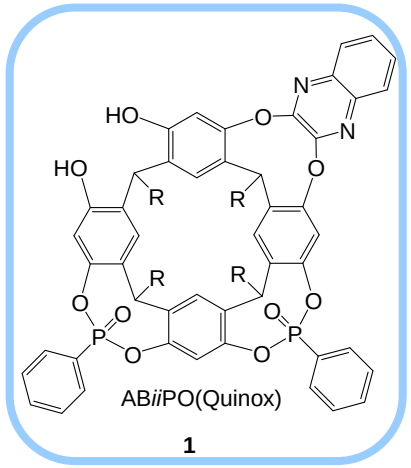
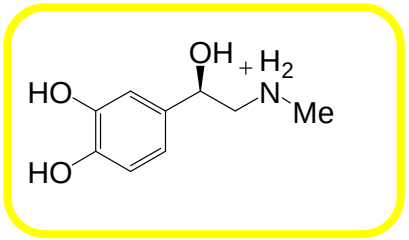
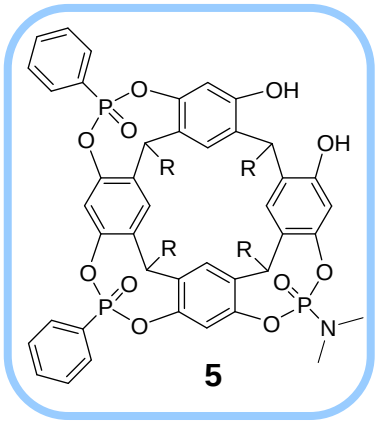
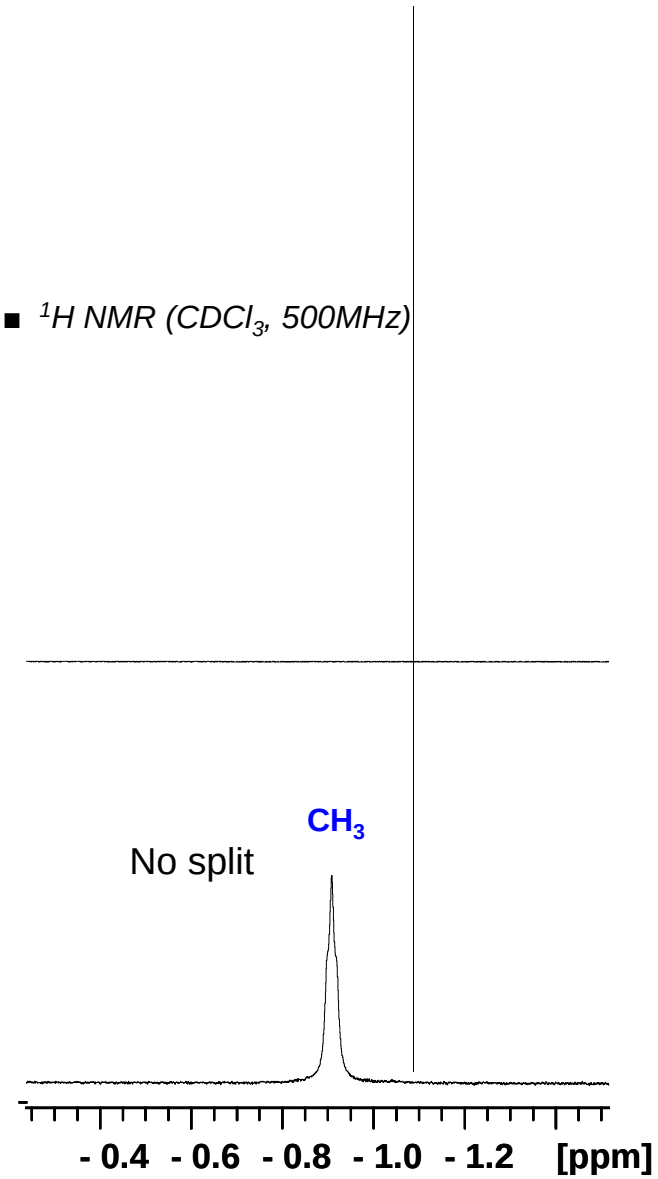


*Figure S60: Complex Adrenaline@(±)-**5***





■ *^{1}H NMR ($CDCl_3$, 500MHz)*



298K, (±)-**5**

298K, (±)-**5** **/**[L-Adr][pic]
1 : 0.4

■ *^{31}P NMR ($CDCl_3$, 500MHz)*

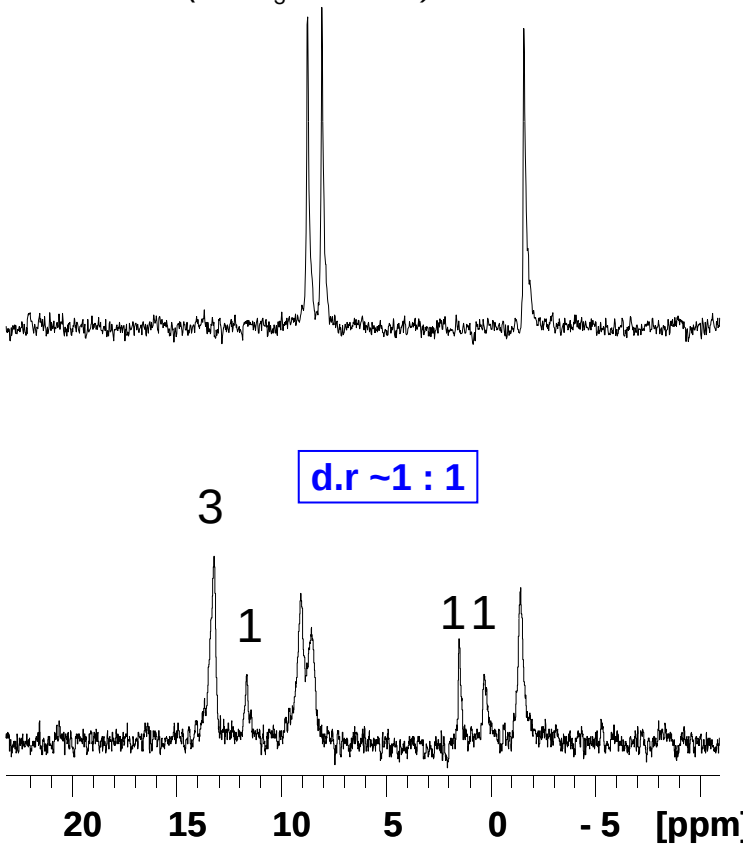
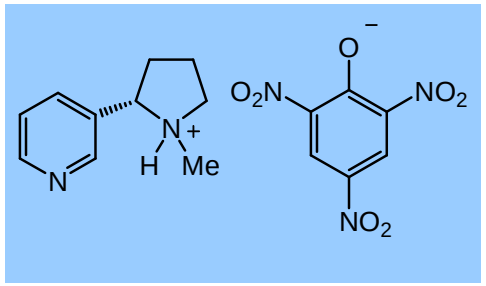
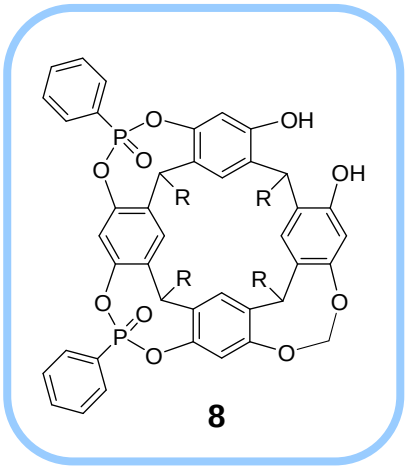
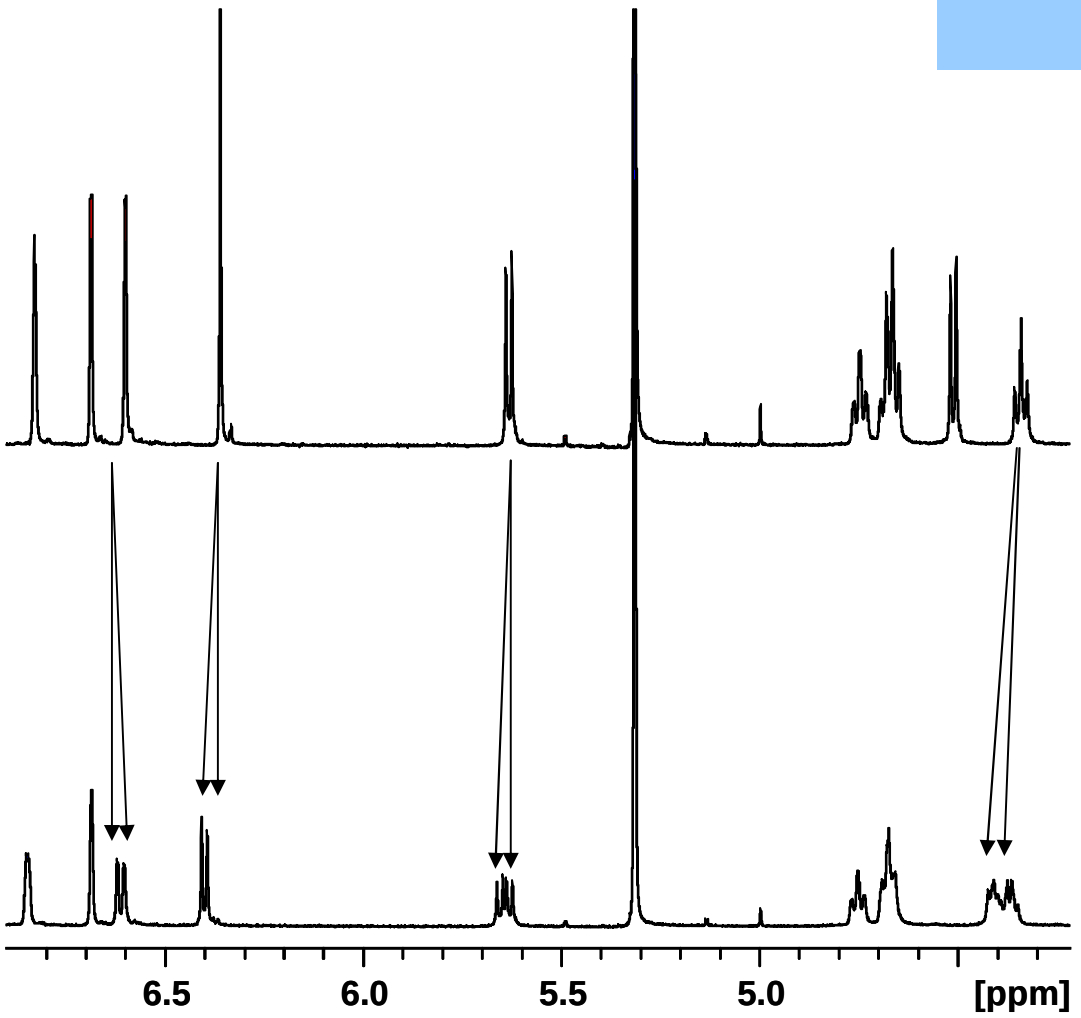


*Figure S61: Complex Nicotine@(±)-**8***





■ *^{1}H NMR (CD_2Cl_2, 500MHz)*



[(+)-***8***]
298K

d.r: 1:1

[Nico]@[(±)-***8***]
0.4:1
298K

■ *^{31}P NMR (CD_2Cl_2, 500MHz)*

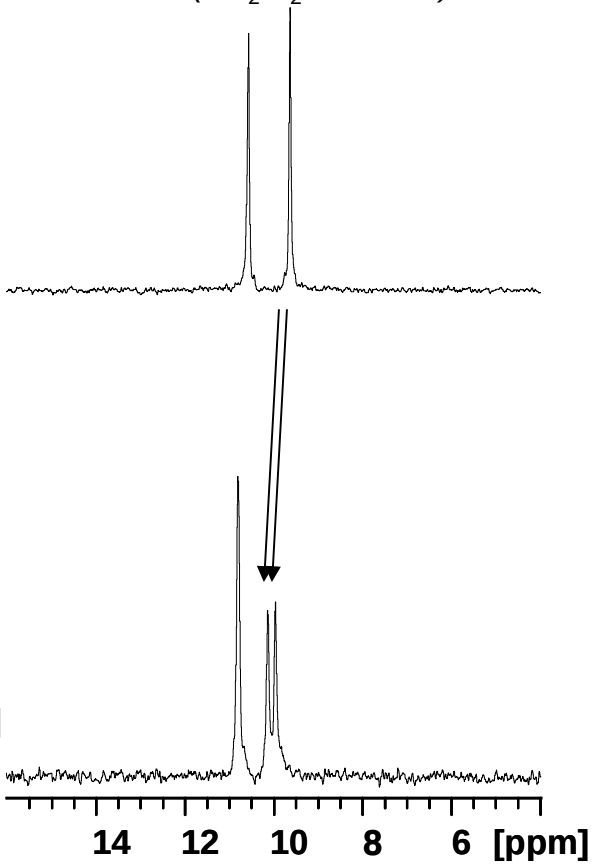
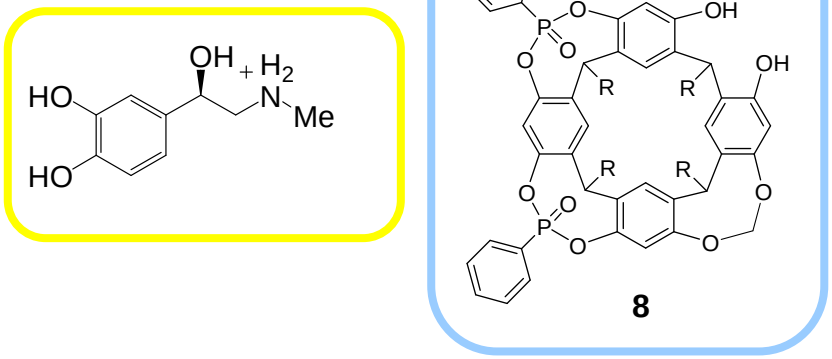


*Figure S62: Complex Adrenaline@(±)-**8***



■ *^{1}H NMR (CD_2Cl_2, 500MHz)*

■ *^{31}P NMR (CD_2Cl_2, 500MHz)*

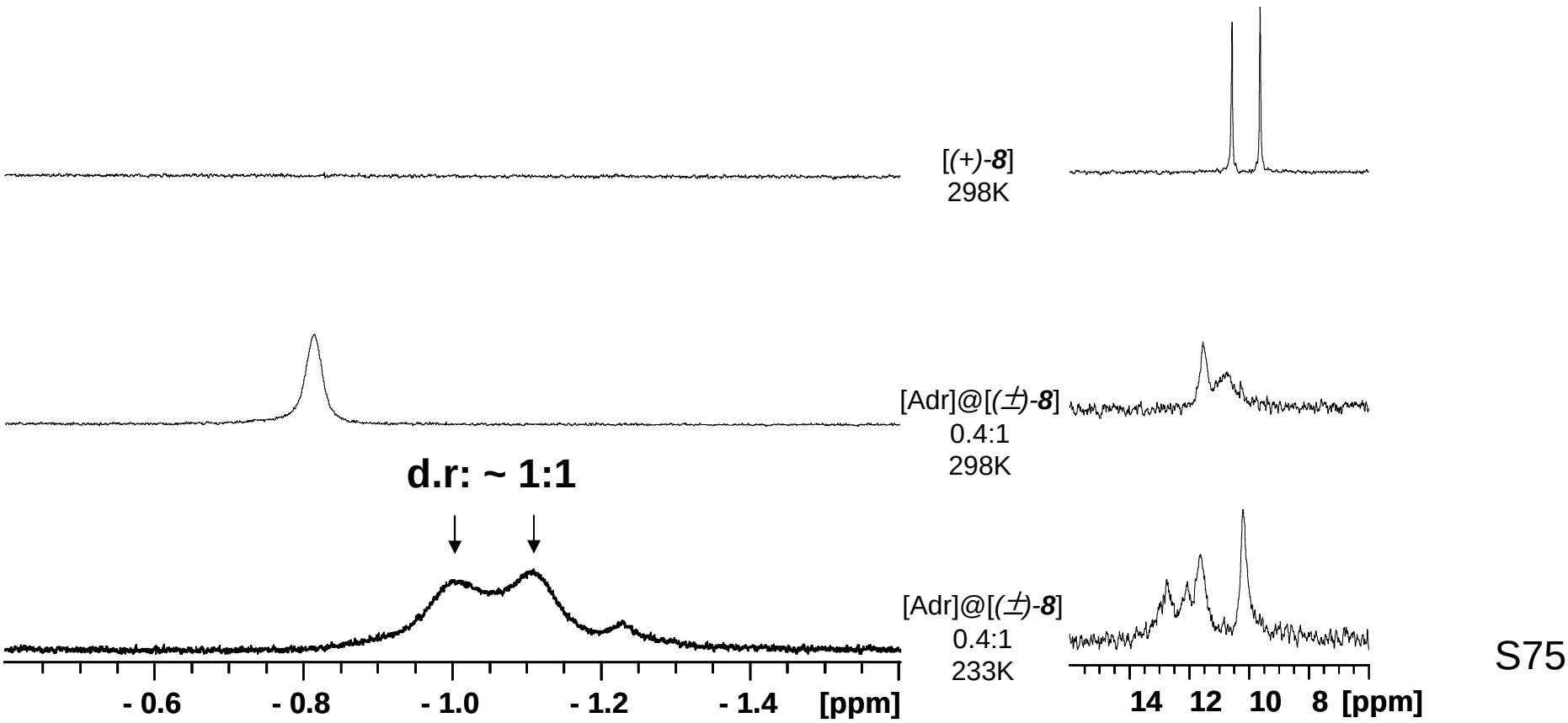
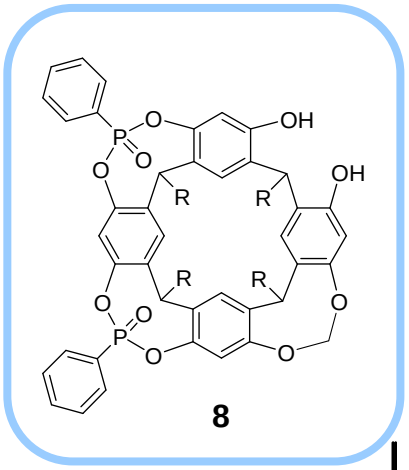
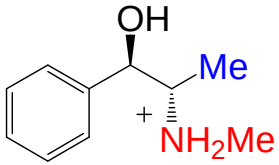


*Figure S63: Complex Ephedrine@(±)-**8***





(–)-(1*R*,2*S*)

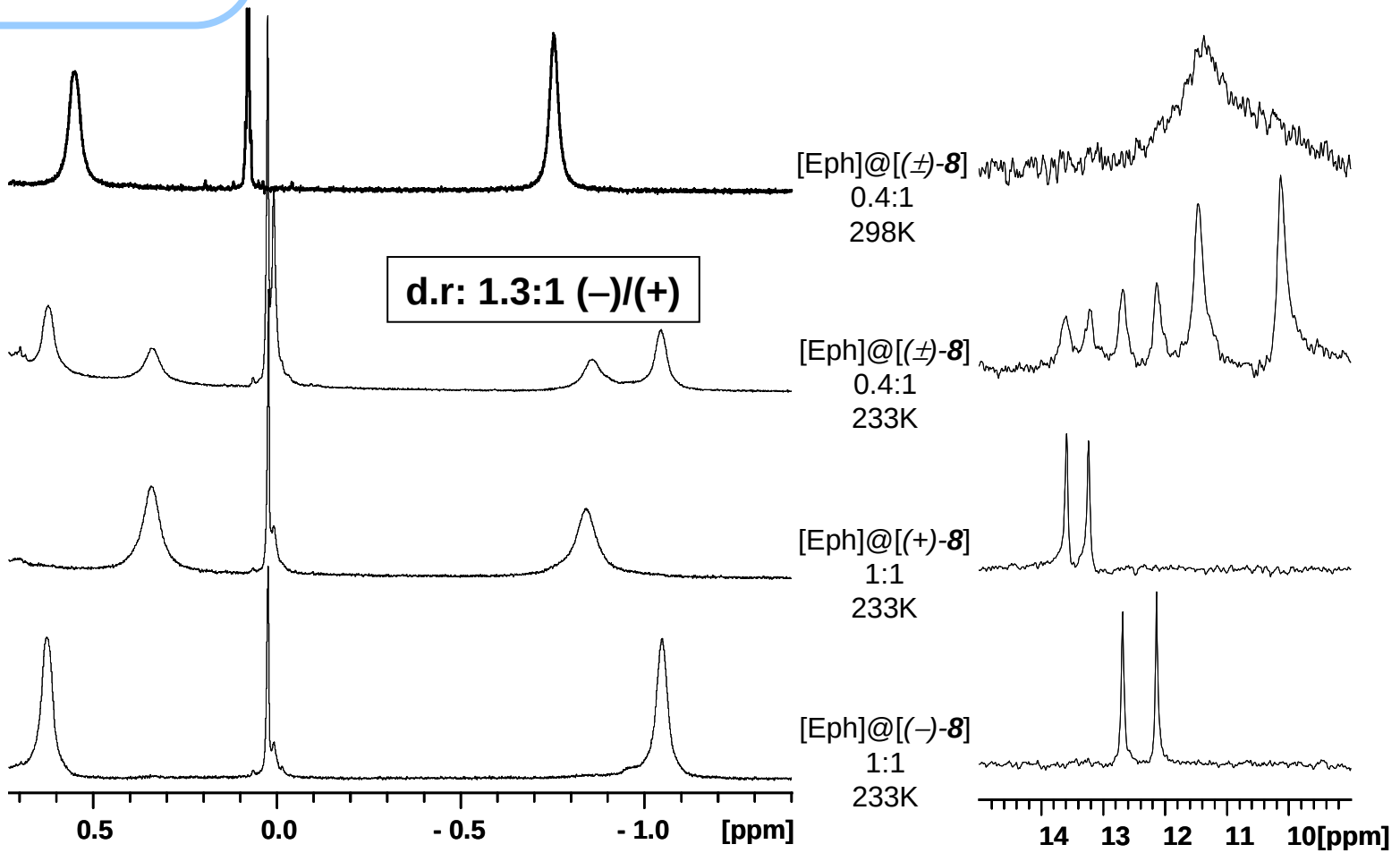
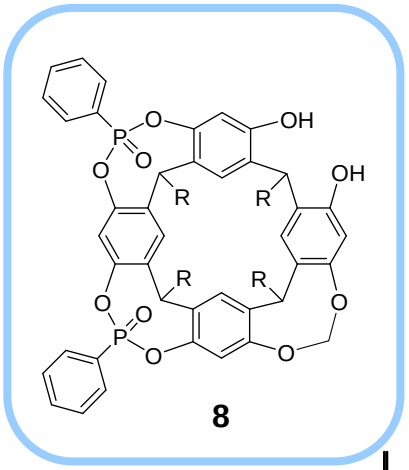
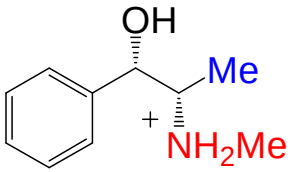


*Figure S64: Complex Pseudoephedrine@(±)-**8***



8



(+)-(1*S*,2*S*)

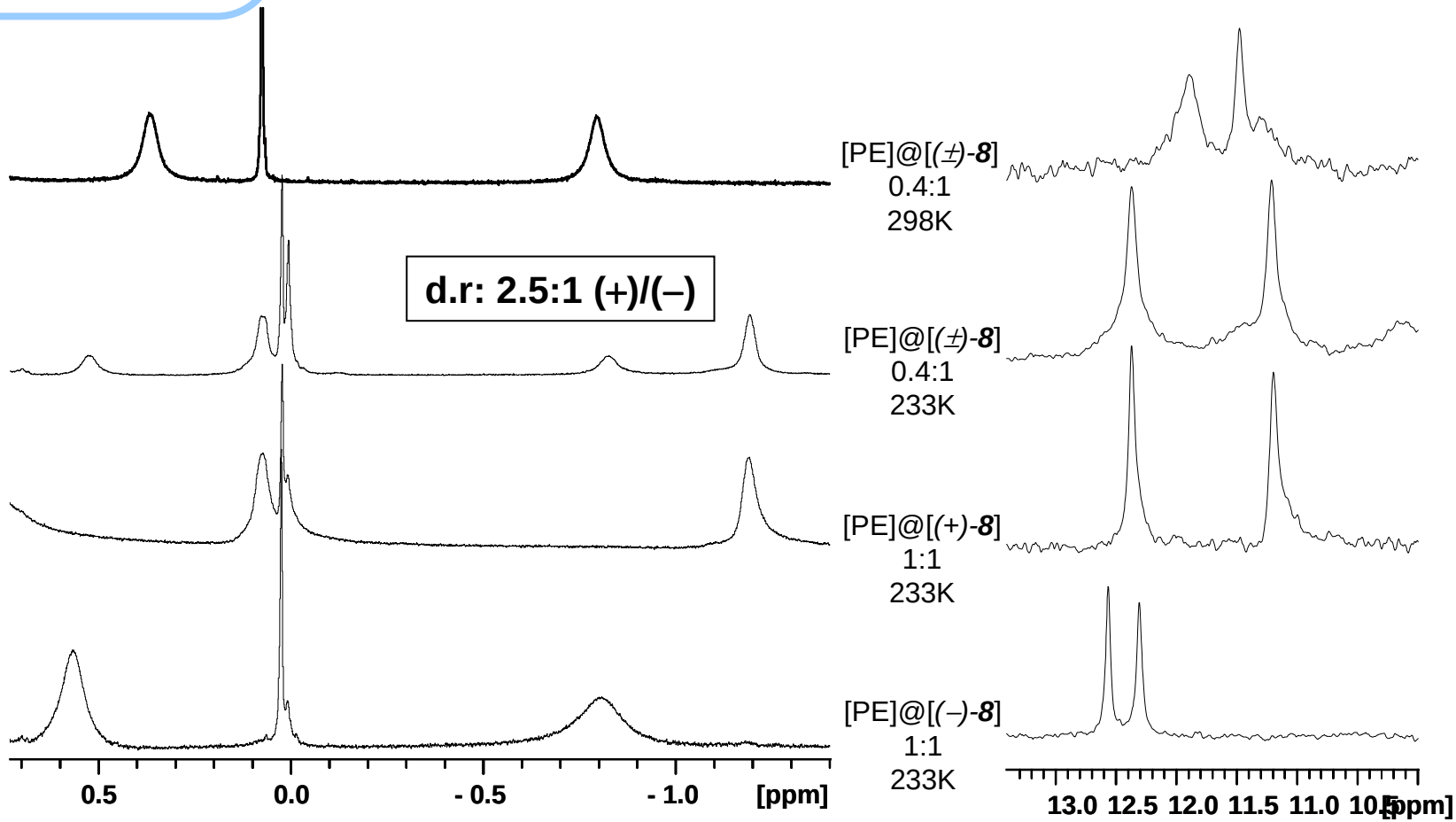
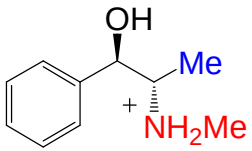
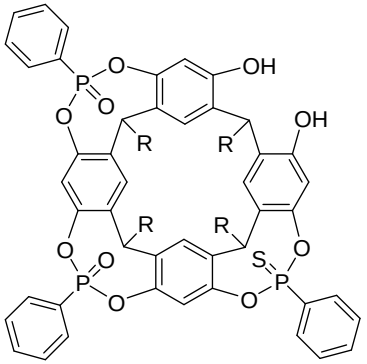


*Figure S65: Complex Ephedrine@(±)-**11***

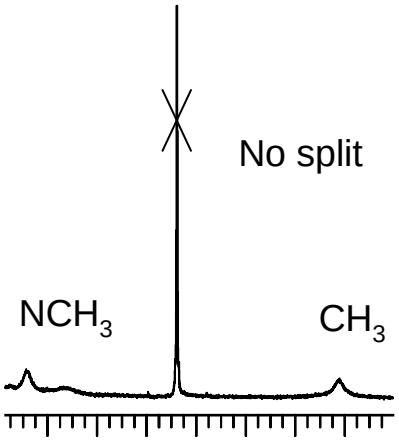


(–)-(1*R*,2*S*)



■ *^{1}H NMR ($CDCl_3$, 500MHz)*

298K, (±)-**11**



298K, (±)-**11** *I*[Eph][pic]
1 : 0.4

0.6 0.4 0.2 0.0- 0.2 - 0.4[ppm]

■ *^{31}P NMR ($CDCl_3$, 500MHz)*

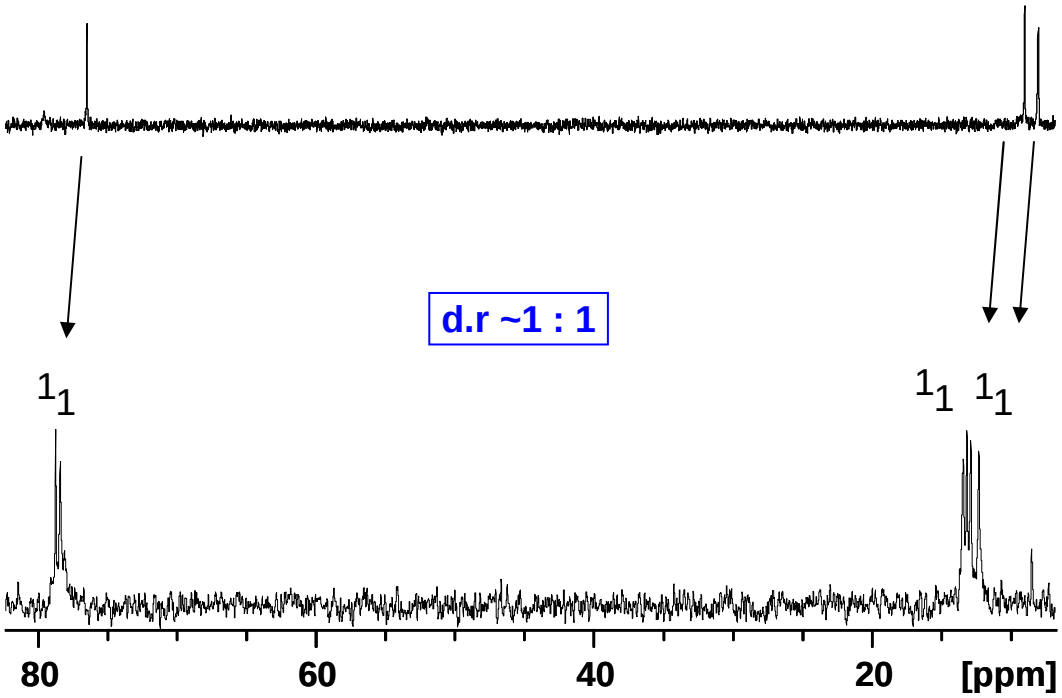
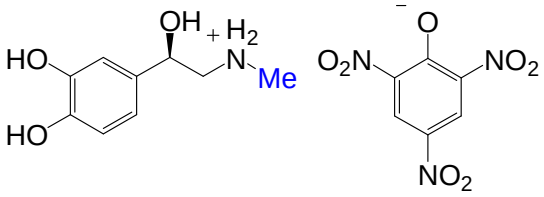
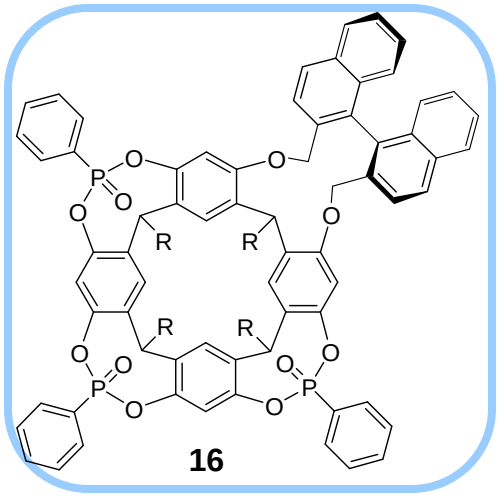
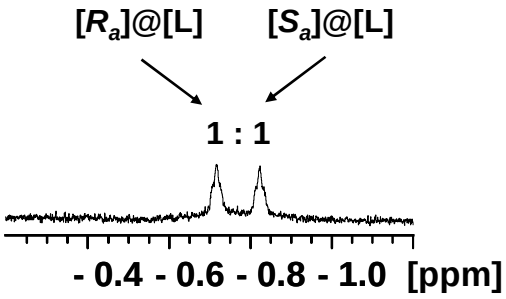


*Figure S66: Complex Adrenaline@(±)-**16***

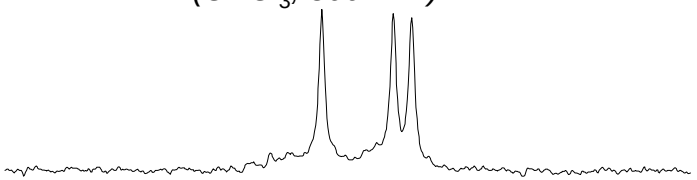




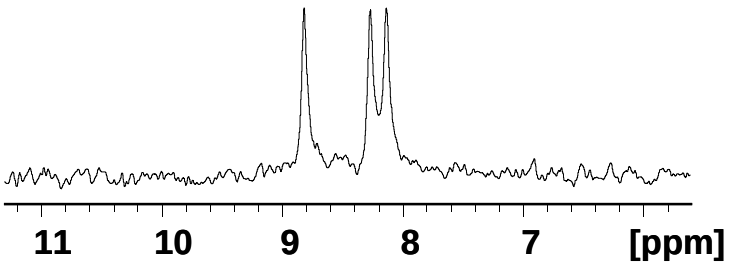
■ *^{1}H NMR ($CDCl_3$, 500MHz)*



■ *^{31}P NMR ($CDCl_3$, 500MHz)*

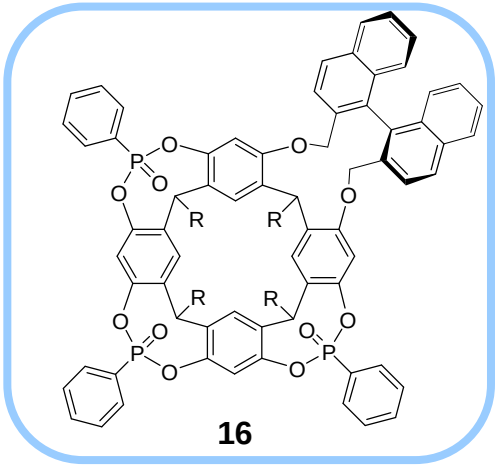


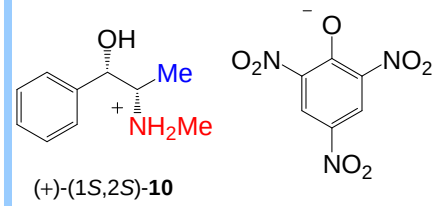
253K, (±)-**16**



253K, (±)-**16**/[L-Adr][Pic]
1:0.4

*Figure S67: Complex Pseudoephedrine@(±)-**16***





(+)-(1*S*,2*S*)-**10**

■ *^{1}H NMR ($CDCl_3$, 500MHz)*

■ *^{31}P NMR ($CDCl_3$, 500MHz)*

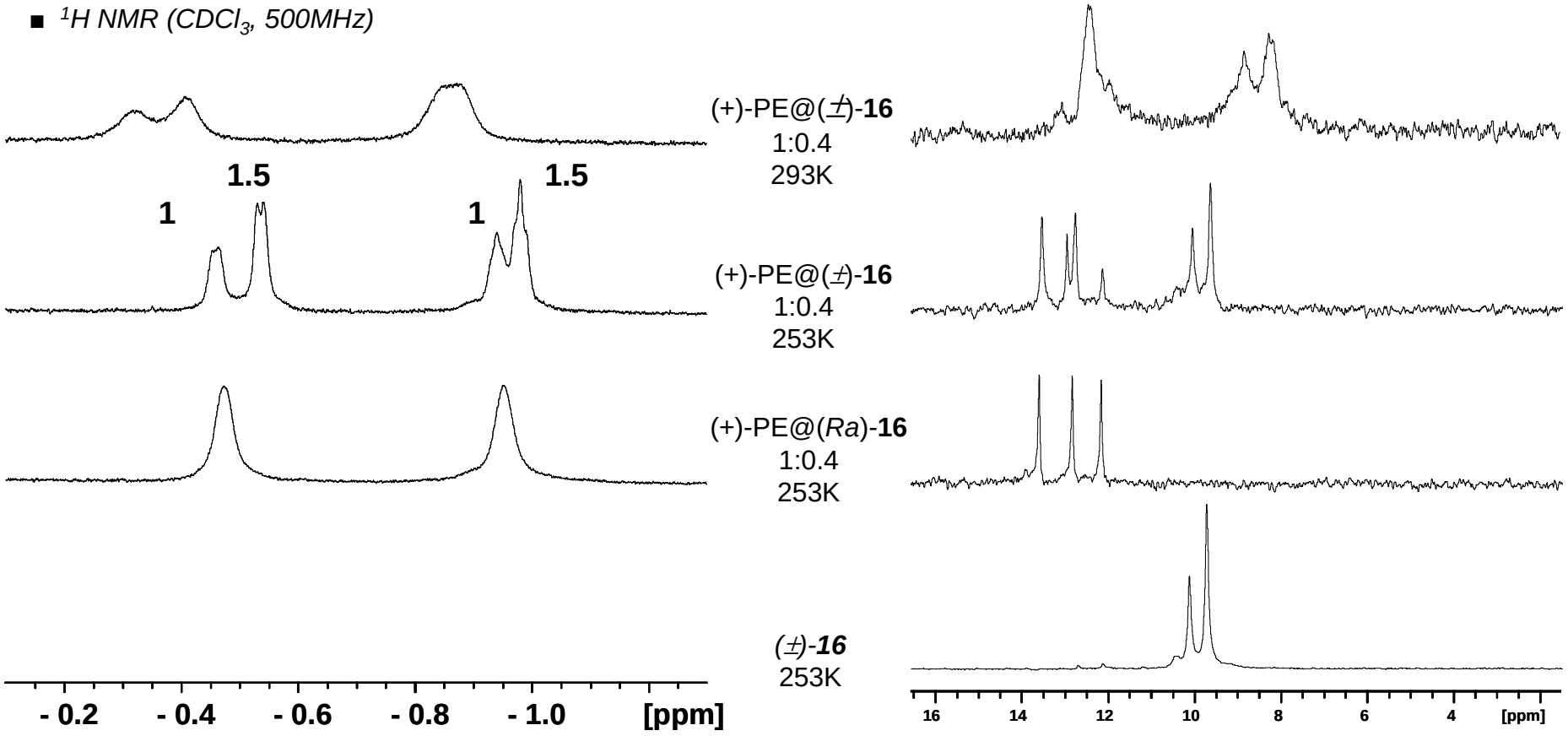
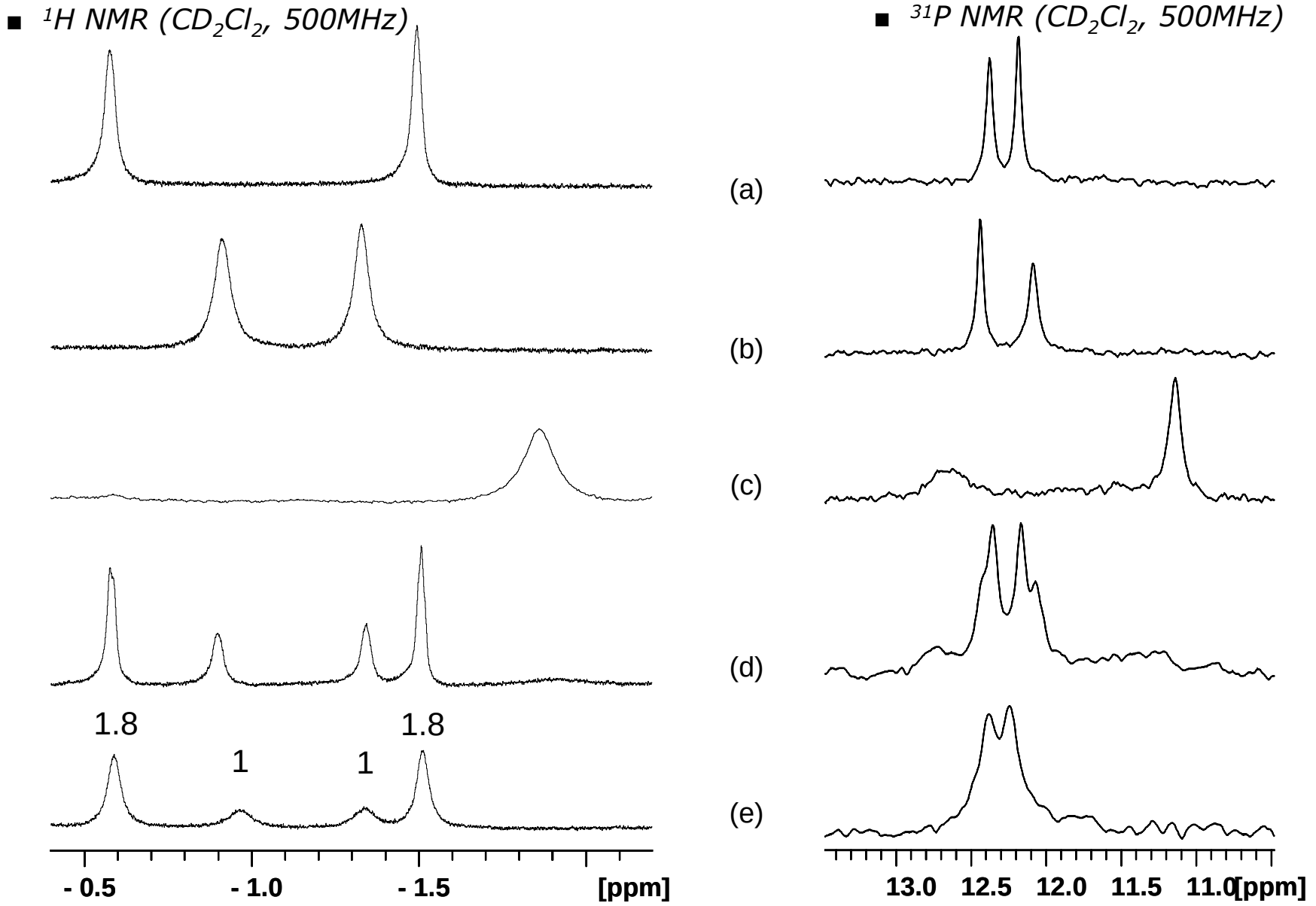
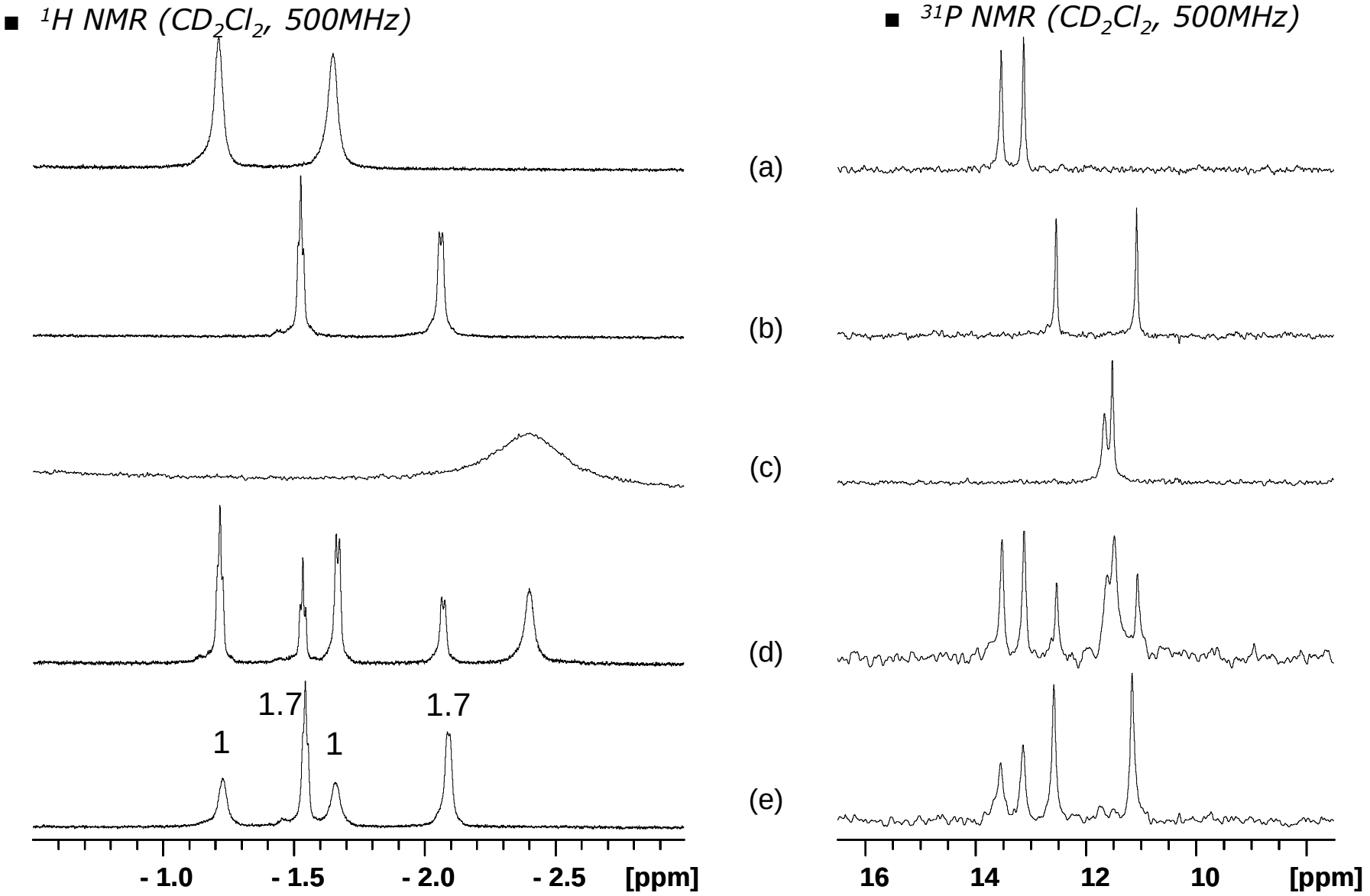


*Figure S68: Chemioselective Experiment: Ephedrine/Pseudoephedrine/Norephedrine@(–)-**1***



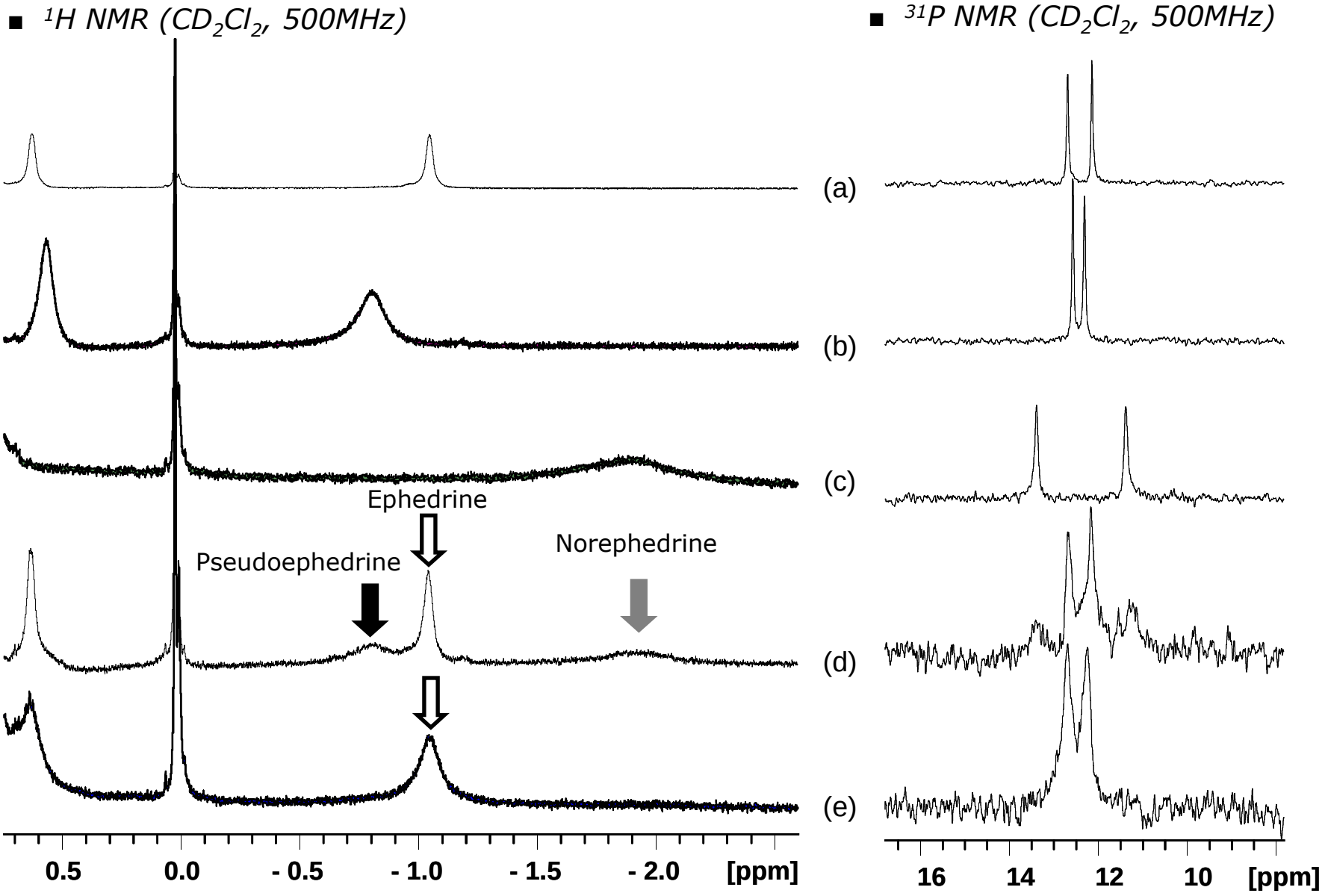
(a) [(–)-**1**]@[Ephedrine] 1:1, (b) [(–)- **1**]@[Pseudoephedrine] 1:1, (c) [(–)-**1**]@[Norephedrine] 1:1, (d) [(–)-**1**]@[Ephedrine] [Pseudo-ephedrine][Ephedrine] 3:1:1:1 and (e) [(–)-**1**]@[Ephedrine][Pseudo-ephedrine][Ephedrine] 1:1:1:1

*Figure S69: Chemioselective Experiment: Ephedrine/Pseudoephedrine/Norephedrine@(+)-**1***



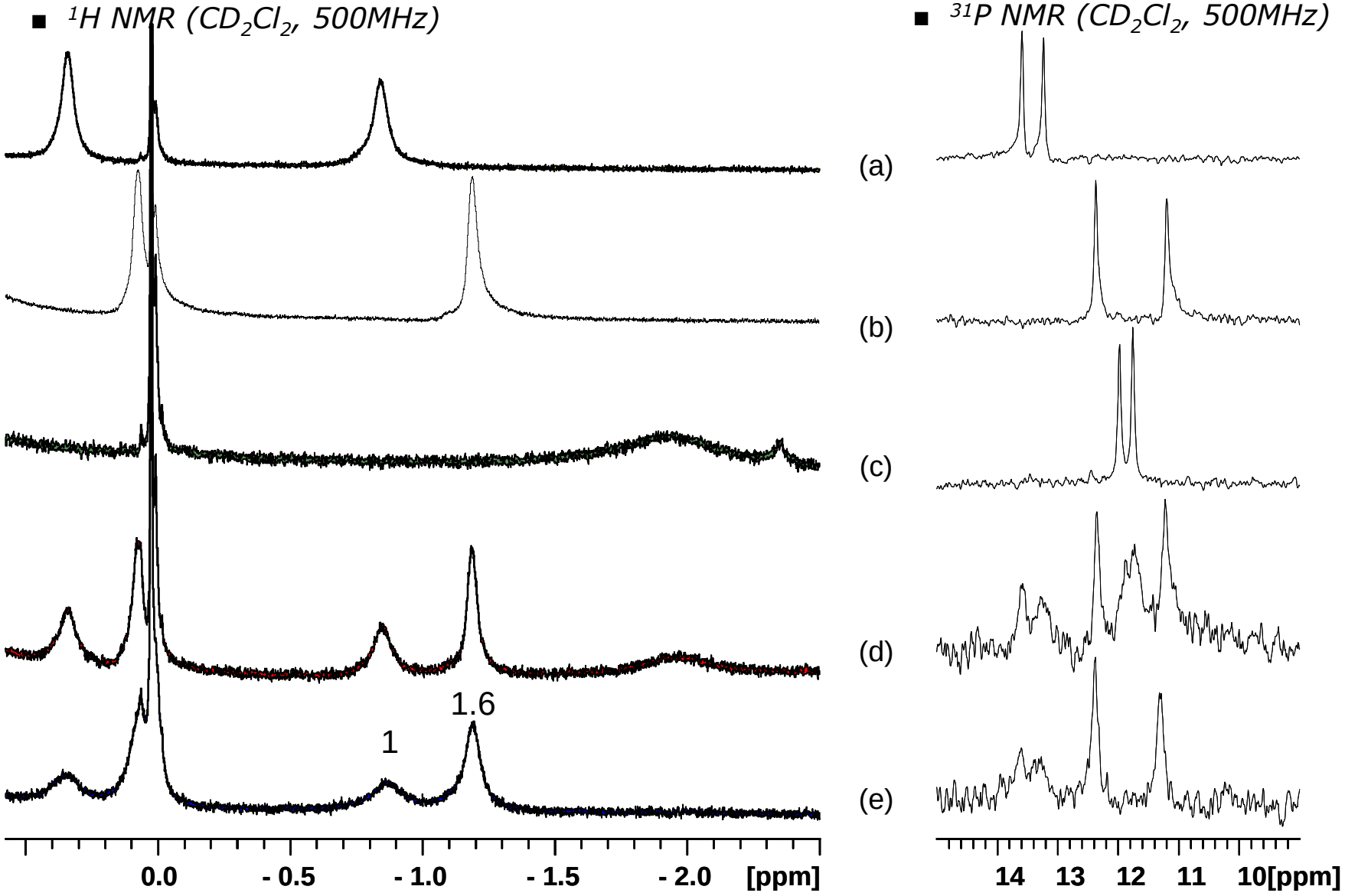
(a) [(+)-**1**]@[Ephedrine] 1:1, (b) [(+)- **1**]@[Pseudoephedrine] 1:1, (c) [(+)-**1**]@[Norephedrine] 1:1, (d) [(+)-**1**]@[Ephedrine] [Pseudo-ephedrine][Ephedrine] 3:1:1:1 and (e) [(+)-**1**]@[Ephedrine][Pseudo-ephedrine][Ephedrine] 1:1:1:1

*Figure S70: Chemioselective Experiment: Ephedrine/Pseudoephedrine/Norephedrine@(–)-**8***



(a) [(–)-**8**]@[Ephedrine] 1:1, (b) [(–)- **8**]@[Pseudoephedrine] 1:1, (c) [(–)-**8**]@[Norephedrine] 1:1, (d) [(–)-**8**]@[Ephedrine] [Pseudo-ephedrine][Ephedrine] 3:1:1:1 and (e) [(–)-**8**]@[Ephedrine][Pseudo-ephedrine][Ephedrine] 1:1:1:1

*Figure S71: Chemioselective Experiment: Ephedrine/Pseudoephedrine/Norephedrine@(+)-**8***



(a) [(+)-**8**]@[Ephedrine] 1:1, (b) [(+)- **8**]@[Pseudoephedrine] 1:1, (c) [(+)-**8**]@[Norephedrine] 1:1, (d) [(+)-**8**]@[Ephedrine] [Pseudo-ephedrine][Ephedrine] 3:1:1:1 and (e) [(+)-**8**]@[Ephedrine][Pseudo-ephedrine][Ephedrine] 1:1:1:1

X-ray crystallography *Data collection:* Processing of the data was performed by the KappaCCD analysis softwares.[2] The lattice constants were refined by least-square refinement. No absorption correction was applied to the data sets.

Structure solution and refinement: Each system was attributed according to the observed systematic extinctions and the structures have been solved in the appropriate space group. The structure was solved by direct methods using the SIR97 program,[3] combined to Fourier difference syntheses and refined against *F* using reflections with [$I/\sigma(I) > 2$] with the CRYSTALS program for all compounds.[4] All atomic displacements parameters for non-hydrogen atoms have been refined with anisotropic terms. After anisotropic refinement, all the hydrogen atoms are found with a Fourier Difference. The crystallographic data and refinement details are in Table S1 ([**8**•$CHCl_3$•CH_3OH] CCDC reference number: 783437; **12** reference number: 783436).

[1] Nonius, *Kappa CCD Program Package: COLLECT, DENZO, SCALEPACK, SORTAV*, Nonius B. V., Delft, Netherlands, 1997-2001.
[2] Cascarano, G.; Altomare, A.; Giacovazzo, C.; Guagliardi, A.; Moliterni, A. G. G.; Siliqi, D.; Burla, M. C.; Polidori, G.; Camalli, M. *Acta Cryst.* **1996**, *A52*, C79.
[3] Watkin, D. J.; Prout, C. K.; Carruthers, J. R.; Betteridge, P. W. *Cristal Issue 11*, Chemical Crystallography Laboratory, Oxford, UK, 1999.

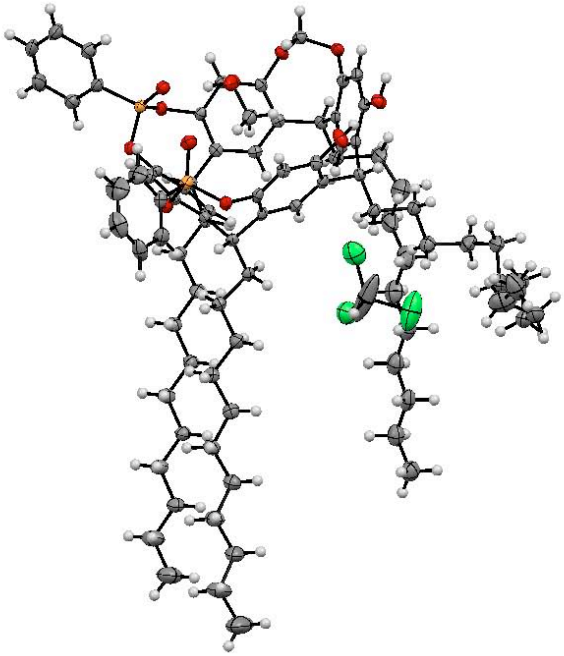


Figure S1. Thermal ellipsoid plot of the crystallographic structure of [**8**•$CHCl_3$•CH_3OH] (probability level 50%).

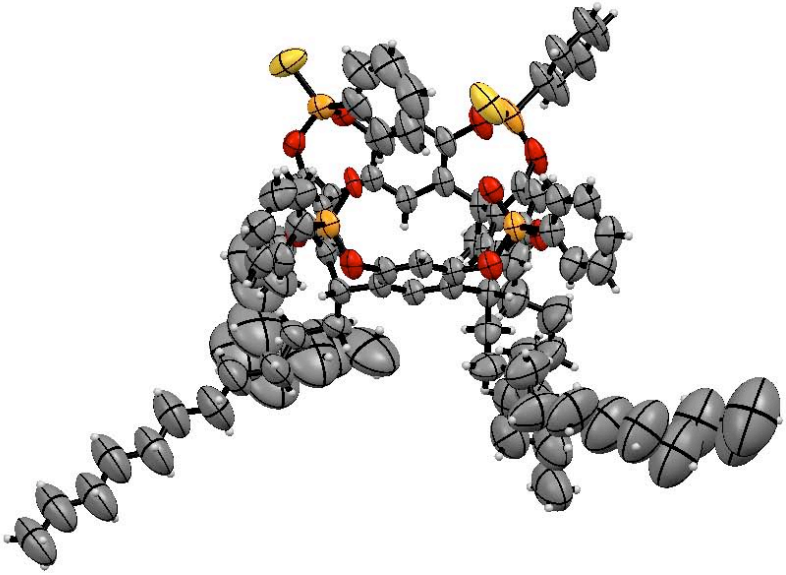


Figure S2. Thermal ellipsoid plot of the crystallographic structure of **12** (probability level 50%).

Table S1. Crystal Data and Structure Refinement for [**8**•$CHCl_3$•CH_3OH] and **12**.

	8•$CHCl_3$•CH_3OH	**12**
molecular formula	$C_{87}H_{123}Cl_3O_{11}P_2$	$C_{96}H_{124}O_{10}P_4S_2$
formula weight	1513.23	1626.06
crystal system	Triclinic	Monoclinic
space group	*P-1* (No. 2)	$P2_1/c$ (No. 14)
Z	2	4
a (Å)	11.9557 (4)	14.338 (1)
b (Å)	15.3805(4)	34.567 (3)
c (Å)	22.8398(6)	18.529 (2)
α (°)	95.810(2)	90.0
β (°)	95.876 (2)	106.02 (1)
γ (°)	90.902(2)	90.0
V (Å^3)	4155.9 (2)	8827 (1)
T (K)	100	100
λ (Kα)	1.5418	1.5418
D_c (g cm^{-3})	1.209	1.224
μ (mm^{-1})	1.816	1.686
h	- 13 - 13	-17 - 16
K	- 17 - 17	0 40
l	0 - 26	0 22
parameters	928	1009
absorption correction	analytical	analytical
reflections collected/unique	60303/13020	64964/15413
unique reflections $I > 2\sigma(I)$	13020	15406
θ_{max} (°)	62.17	67.35
R_{int}	0.050	0.063
Goodness-of-fit	1.042	1.07
R_1 $(I > 2\sigma(I))$ [a]	0.092	0.130
wR_2 $(I > 2\sigma(I))$ [b]	0.200	0.295
$\Delta\rho_{min}$ / $\Delta\rho_{max}$ (e Å^{-1})	–1.67 / 2.55	–1.37 /1.21

[a] $R_1 = \Sigma||F_o|-|F_c||/\Sigma|F_o|$; [b] $wR_2 = \Sigma[w((F_o^2-F_c^2)^2/\Sigma wF_o^4]^{1/2}$